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VOLUME 7 • JANUARY 1949 • NUMBER 1 JOURNAL OF ORAL SURGERY

The necessity for routine roentgenographic examination of the edentulous patient

■ *LeRoy M. Ennis,* D.D.S., Harrison M. Berry, Jr.,† D.D.S., Philadelphia*

The innocent-appearing edentulous arches, devoid of teeth and without visible signs of infection, require as much if not more careful consideration than any other problem in the dental field. It must be assumed that if some type of pathologic condition had not existed previously the teeth would still be present; and it is the dentist's responsibility to make certain that such conditions have been eliminated before proceeding with the construction of prosthetic appliances.

■ *Review of the Literature*

Numerous investigators already have reported that too often these pathologic areas have not been eradicated, and that beneath the edentulous ridges lie many areas needing further attention. The roentgenogram is the only means of detecting such conditions. This paper presents the findings in the roentgenograms of 1,002 edentulous and partially edentulous patients to emphasize the necessity for such an examination, together with a description of the technic employed therein.

Since W. H. G. Logan[1] first reported on the roentgenograms of 35 edentulous jaws in 1921, many other excellent studies have appeared in the professional journals. In his study, Logan found 5 root fragments "with normal appearing overlying tissues having definite periapical rarefied areas"; 3 root fragments "with normal appearing overlying tissues without periapical rarefied areas"; 2 "rarefied areas remaining unhealed after removal of teeth," and 2 "embedded teeth."

Eusterman,[2] also in 1921, found that 89 patients wearing dentures had 129 roots. He also found 13 embedded and partially erupted teeth.

In 1925, F. F. Molt[3] examined 900 areas and stated that 48 per cent showed remaining roots or evidences of residual or retained infection.

Read before the Section in Roentgenology, eighty-ninth annual session of the American Dental Association, Chicago, September 15, 1948.

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1. Logan, W. H. G., Should All Pulpless and Impacted Teeth Be Removed? *J. Nat. D. S.* 8:126, table p. 131 (February) 1921.

2. Eusterman, M. F., Roentgenographic Findings in 290 Partially Edentulous or Edentulous Mouths. *D. Cosmos* 63:901 (September) 1921.

3. Molt, F. F., The Value of Roentgenograms in Edentulous Mouths. *J.A.D.A.* 12:788 (July) 1925.

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In 1927, T. J. Cook[4] found roots and 5 unerupted teeth in 29 per cent of 120 edentulous mouths (after an average of six years of wearing dentures). In 26 per cent of 305 patients wearing full upper dentures, there were roots (after an average of ten years of wearing dentures) and 6 unerupted teeth. Seventy-five patients wearing full lower dentures showed 20 per cent roots (after an average of four and a half years of wearing dentures) and 2 unerupted teeth. Out of 500 patients examined, 130 were wearing dentures with roots underneath.

Further proof that roentgenographic examination of edentulous regions is necessary was demonstrated by Gardner and Stafne[5] at the Mayo Clinic. Their aim was "to compare the service (removal of teeth) we had been able to render using our technic with the service which the public receives in general." To accomplish this they examined a group of patients who had teeth removed elsewhere and compared the results with a group of patients who had teeth extracted at Mayo Clinic "by four different operators using the same definite technic." In the group of 2,112 patients (20,000 edentulous areas) who had teeth removed elsewhere, 469 (22.2 per cent) had one or more root

4. Cook, T. J., Statistics Obtained by Clinical and Roentgenographic Examinations of 500 Edentulous and Partially Edentulous Mouths. *D. Cosmos* **69**:349 (April) 1927.

5. Gardner, B. S., and Stafne, E. C., Incidence of Failure in the Removal of Teeth. *Am. D. Surgeon* **49**:321 (July) 1929.

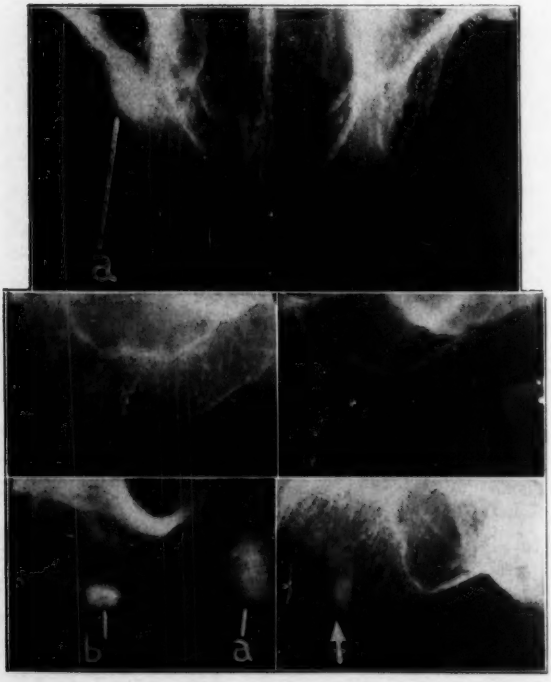

Fig. 1.—A: Maxillary occlusal roentgenogram of area of condensing osteitis (a) in left first molar region. The residual root (b) lying in left third molar region appears in periapical roentgenogram but lies too far posteriorly to appear in occlusal one. B: Residual root fragments of a right maxillary first bicuspid are indicated by arrow

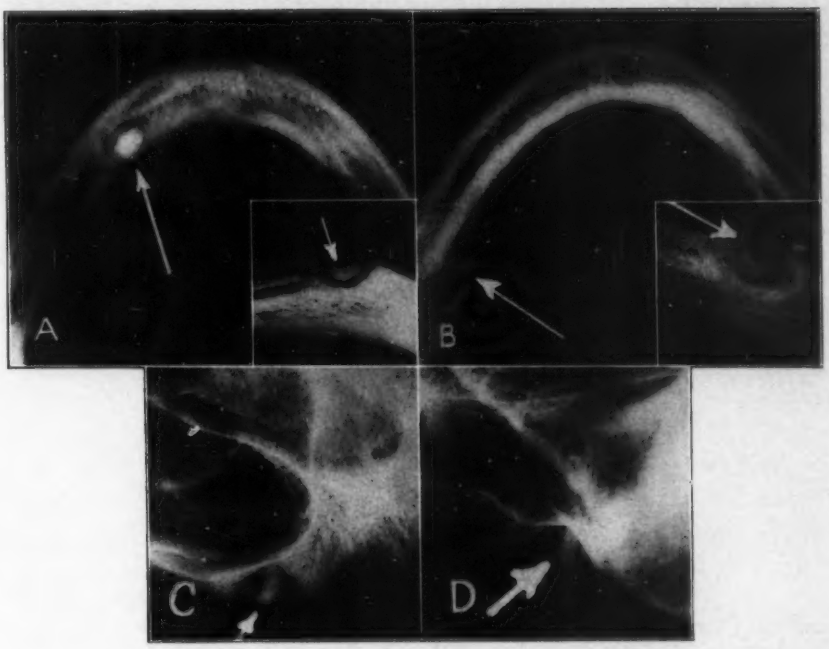

Fig. 2.—A: Residual root fragments (arrows) associated with radiolucent area appear in both occlusal and periapical (inset) roentgenograms. B: Root fragments (arrows) of mandibular left first molar associated with radiolucent area, in both occlusal and periapical (inset) roentgenograms. C: Maxillary left bicuspid root fragment (arrow) associated with radiolucent area. D: Maxillary right first molar root fragment (arrow)

tips remaining. From the 20,000 teeth removed, 903 root tips remained.

Concerning this group they state: "The removal of upper teeth was apparently less difficult than the removal of lower teeth; there was a failure of 3.35 per cent in removal of upper teeth and of 5.75 per cent in removal of lower teeth. As a group the first bicuspid teeth presented the highest percentage of failure."

The group of 5,808 patients who had 20,000 teeth removed at Mayo Clinic revealed 59 root tips, and no one patient had more than one. More were found in the maxilla than in the mandible in this series. They state that "this series then presents failure in 1.01 per cent of the patients operated on as compared with 22.2 per cent in the series of patients from whom teeth had been removed elsewhere."

In commenting on these findings they stated: "One must conclude that routine post-operative roentgenograms are indispensable when under the most favorable conditions there is a failure completely to remove teeth in about one out of every 100 patients operated on. The average inefficiency in the extraction of teeth is far from good when one realizes that in 22.2 per cent, or in about one of every five patients

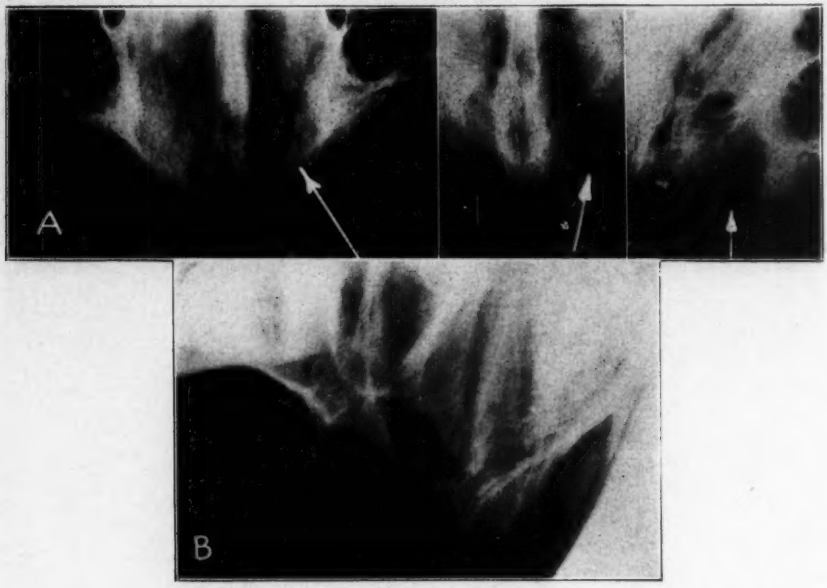

Fig. 3.—A: Residual area of infection (arrows) appears in maxillary occlusal and periapical roentgenograms. B: Residual area of infection extending from maxillary first incisor region to left first molar region. Biopsy of this region was negative for malignancy

who have had dental extractions, one or more roots remain.

In 1936 Cheppe[6] examined the roentgenograms of 190 edentulous patients and reported positive findings in 68 cases (35.1 per cent). Fifty-eight patients had 95 roots; 2 patients had 2 cysts; 2 patients had residual granulomas, and 9 patients had 11 impactions.

Also from the Mayo Clinic, Waggener and Austin[7] in 1941 reported on the findings in 1,948 edentulous jaws. Five hundred and sixty-eight (568) patients were completely edentulous and 27.4 per cent had roots remaining; 748 patients were edentulous in the maxilla and 15.5 per cent had roots remaining; 64 patients with edentulous mandibles showed 15.6 per cent with roots remaining. Forty-three unerupted teeth remained (not including supernumerary teeth); the maxillary left third molar was the most commonly unerupted tooth. There were 8 supernumerary teeth. Out of the entire series, 23.8 per cent of the patients had roots, unerupted or supernumerary teeth remaining. There were also 11 cysts revealed, "six of which were median anterior maxillary cysts, and five were cysts associated with dental structures."

Swenson found that, out of 381

6. Cheppe, Erwin, Tabulation and Analysis of the Results of X-Ray Examinations of Edentulous Mouths. *Northwestern U. Bull.* **36**:12 (Feb. 3) 1936.

7. Waggener, D. T., and Austin, L. T., Dental Structures Remaining in 1,948 Edentulous Jaws: A Statistical Study. *J.A.D.A.* **28**:1855 (November) 1941.

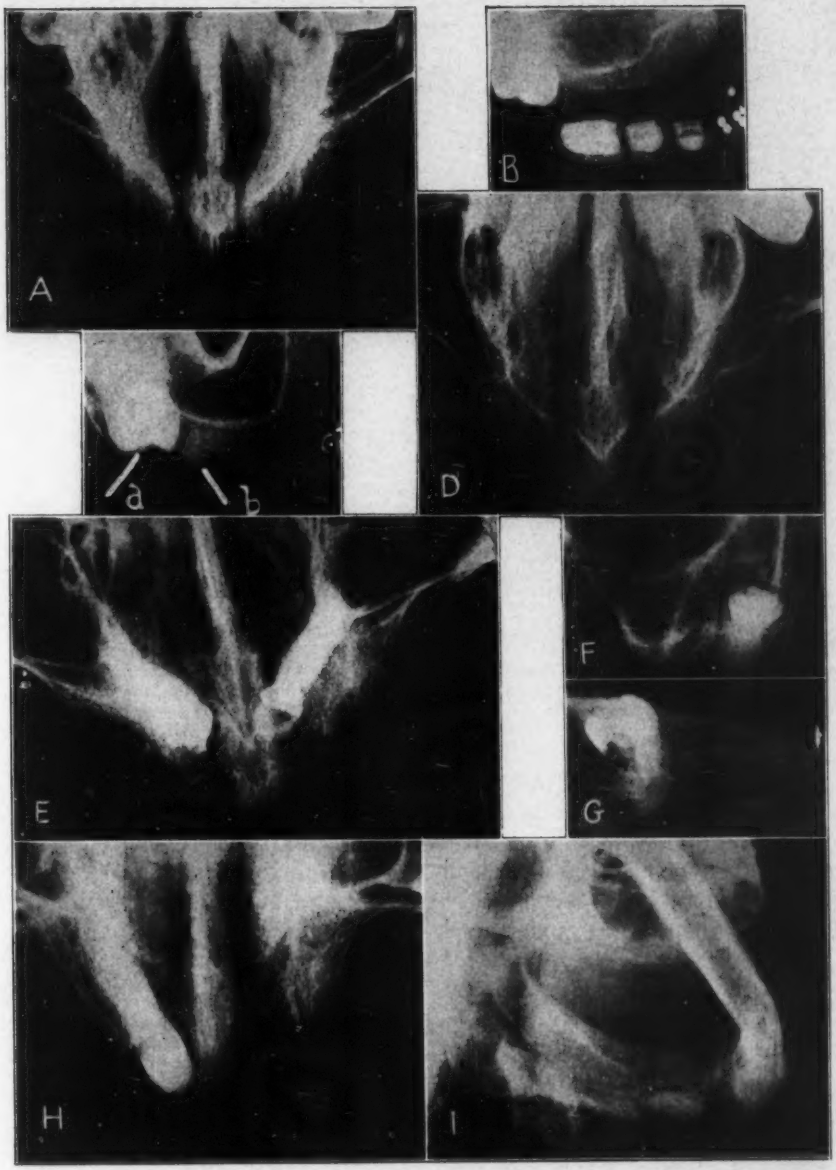

Fig. 4.—A: Impacted maxillary third molars. B: Maxillary third molar erupting under denture. C: Impacted maxillary left third molar (a); residual root fragment (b). D: Impacted maxillary right third molar. E: Impacted right and left maxillary cuspids. Right cuspid shows absorption of crown. F: Inverted impaction of maxillary right third molar. G: Impacted mandibular left molar. Note absorption. H: Impacted maxillary left cuspid near surface. Note developmental crypt surrounding crown. I: Horizontally impacted mandibular left bicuspid which became infected through socket of cuspid. A fistula had opened at lower border of mandible

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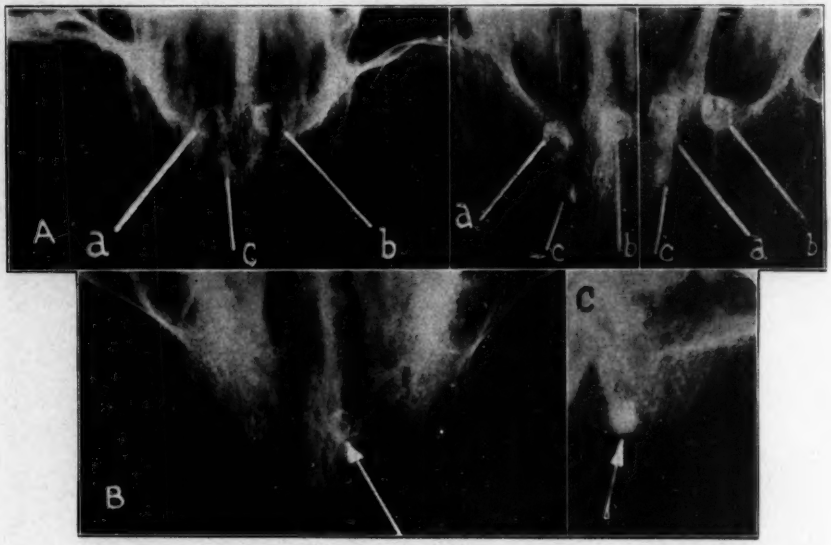


Fig. 5.—A: Occlusal and periapical roentgenograms showing supernumerary teeth (a and b). Development of these teeth was arrested at an early stage. Root tip of left first incisor is shown in (c). B: Supernumerary tooth (arrow), partially developed, similar to those in A. C: Supernumerary tooth (arrow); although not fully developed, this tooth has shape of an incisor and is embedded with crown pointing posteriorly. The portion between crown and root apex seems to be undergoing absorption

edentulous patients, 122 (31.23 per cent) had 188 retained roots.[8] Of all these root tips, 75 per cent were in the maxilla, and more in the maxillary left second molar area than in any other one area. Nine and six tenths (9.6) per cent of the retained root tips were associated with radiolucent areas.

In a study of 1,000 edentulous cases at the College of Dentistry, University of Iowa, in 1946, Earle S. Smith[9] reported positive findings in the roentgenograms of 22.4 per cent of the cases. An analysis of this shows 15.7 per cent root tips; 3.8 per cent unerupted teeth; 2.1 per cent foreign material, and 0.8 per cent cysts, making the total of 22.4 per cent. Nearly twice as many roots were found in the maxilla as in the mandible.

A review of the literature has been presented in order to emphasize the fact that not only the results of our survey, but of many similar ones, prove the great necessity for routine roentgenographic studies of edentulous areas. The impressive fact is that in all of these studies, and those of our own, approximately one out of every 4 edentulous patients has residual roots, unerupted and super-

8. Swenson, H. M., Roentgenographic Examination of the Edentulous Mouth. *J.A.D.A.* 31:475 (April 1) 1944.

9. Smith, E. S., Findings in the Roentgenograms of Edentulous Patients. *J.A.D.A.* 33:584 (May 1) 1946.

The terminology in this article is that authorized by the Committee on Nomenclature and does not necessarily conform with the preferences of the author, for example, cuspid instead of canine and bicuspid instead of premolar.

numerary teeth, cysts, residual areas of infection, foreign bodies and so forth, all of which should be detected and most of which should be removed.

■ *Clinical Investigations*

Our survey was made from the routine roentgenographic examination required of all edentulous patients at the clinic of the School of Dentistry, University of Pennsylvania, for prosthesis. By means of the technic described in this paper, 950 completely edentulous patients and 52 patients with one edentulous arch were studied, making a total of 1,002 patients (or 1,952 edentulous jaws; or 31,232 tooth areas). Of these, 563 patients were females, and 439 were males. The average age was 54 years, with the youngest 20 and the oldest 89.

Of the total number, 244 patients (24.4 per cent) had a total of 355 roots (Fig. 1); 21 (5.9 per cent) of the roots were associated with radiolucent areas (Fig. 2); 14 (1.4 per cent) of the patients had residual areas of infection (Fig. 3); 27 (2.7 per cent) of the patients had a total of 32 impacted or unerupted teeth (Fig. 4); and 5 (0.5 per cent) had supernumerary teeth (Fig. 5).

Ten patients (1.0 per cent) had cysts, as follows: 6 residual dental root cysts (Fig. 6); 3 median (anterior palatine) cysts (Fig. 7), and 1 mucous cyst of the antrum (Fig. 8).

Twelve patients (1.2 per cent) revealed foreign bodies, as follows: 7 with bits of amalgam, 1 with buckshot from a hunting accident thirty years previously, 2 with broken tips of broaches (Fig. 9), and 2 with fragments of impression paste in the antrum (Fig. 10). Nine (0.9 per cent) had 11 stones in Wharton's ducts (Fig. 11), 9 of which were small and 2 of which were large, necessitating removal; 5 patients (0.5 per cent) had a total of 11 odontomata (Fig. 12).

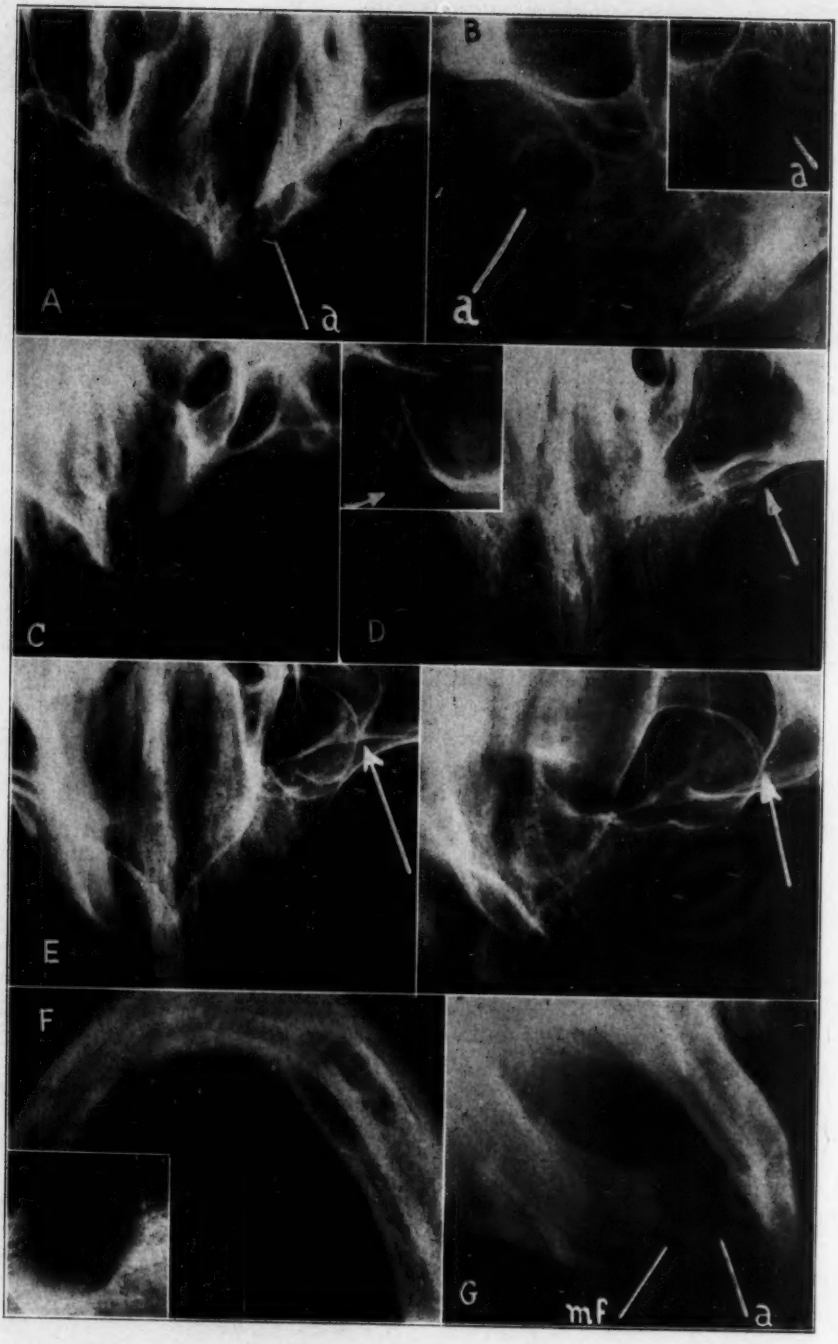
Thirteen patients (1.3 per cent) had sequestrums at the crest of the ridge (Fig. 13), and 1 patient revealed a fractured alveolar process in the maxillary incisor region; 3 (0.3 per cent) of the patients revealed suspicious areas which prompted requests for biopsies, the results of which were carcinoma in two cases (Fig. 14), the third being negative for malignancy.

The number of roots remaining in the maxilla was 244, while 111 remained in the mandible. From the accompanying chart (Fig. 15) showing the situation of the roots remaining, it can be seen that the maxillary left second molar roots were most commonly retained. In the studies by Waggener and Austin,[7] by Swenson[8] and by Cheppe[6], the maxillary left second molar was also found to be the most common site for retained roots.

Of the 32 unerupted teeth (Fig. 16), 25 were in the maxilla and 7 were in the mandible, the maxillary left third molar being the one most often found unerupted. Waggener and Austin[7] reported 30 in the maxilla and 13 in the mandible, the maxillary right and left third molars being the most common sites with 9 teeth in each area.

■ *Technic*

The routine technic employed in our study involves the use of upper and lower occlusal films, plus periapical films in the right and left molar regions (both maxilla and mandible), and the lower anterior region; this makes a total of seven films used routinely. Originally a periapical film of the lower anterior region was not taken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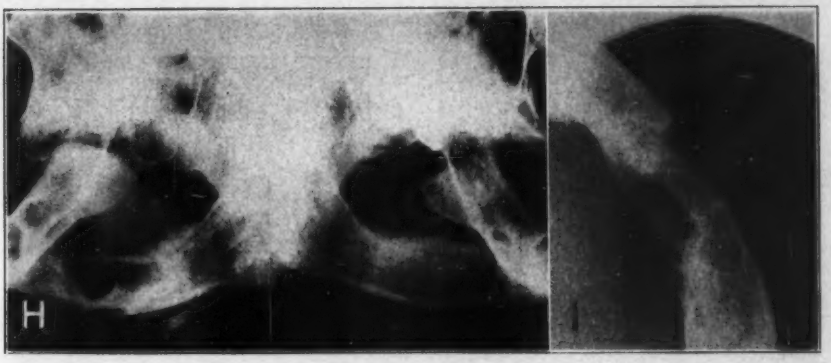

Fig. 6.—A: Residual dental root cyst (a) involving right incisor and cuspid region. B: Occlusal and periapical (inset) views of residual dental root cyst (a) extending to anterior border of maxillary sinus. C: Large residual dental root cyst involving right side of maxilla. D: Residual dental root cyst (arrow) in maxillary right first molar area, as seen in occlusal and periapical (inset) views. E: Normal variation of maxillary sinus, for comparison with D. Arrow points to bony septum which, in this plane, appears to divide sinus into anterior and posterior chamber. F: Residual dental root cyst in mandibular right bicuspid region, occlusal and periapical (inset) films. G: Residual dental root cyst (a); metal foramen (mf). H: Multilocular mandibular cyst. I: Occlusal view of same cyst, (Case taken after statistics had been compiled)

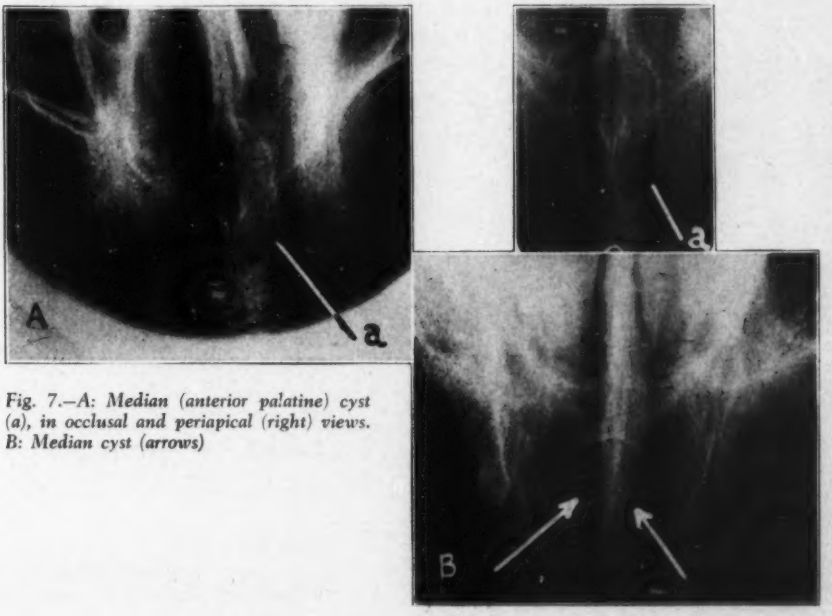

Fig. 7.—A: Median (anterior palatine) cyst (a), in occlusal and periapical (right) views. B: Median cyst (arrows)

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Fig. 8.—Mucous cyst of right antrum (arrows). These cysts do not arise from dental apparatus but from mucous cells in mucous membrane lining sinus. Mucous contained in cyst accounts for typical "cloudy" or radiopaque appearance

routinely, but after a series of checks it was found that some small root fragments were being missed by the mandibular occlusal film. This was attributed mainly to two factors: (1) the small anatomic size of the roots of the mandibular incisors to start with and (2) the fact that the dense mental ridge often obscures these root fragments in the projection employed in the lower occlusal film technic. This error was then corrected by the inclusion of a periapical film of this region in the routine series.

The occlusal roentgenograms give what might be called a "bird's-eye view" of the entire maxillary and mandibular arches, affording an excellent perspective in a buccolingual plane and showing the relative position of a root, unerupted tooth and so forth to the normal landmarks, which a periapical roentgenogram cannot do.

The occlusal roentgenogram does not, however, afford the detail which a periapical one gives; therefore when a root or other object is seen in the occlusal roentgenogram (Fig. 17), a periapical roentgenogram (Fig. 17) of that region is taken, giving sharpness of detail plus localization of the area in two planes: (1) the vertical plane as shown in the periapical film and (2) the horizontal plane as shown in the occlusal film.

In taking the maxillary occlusal roentgenogram, the patient is seated so that the occlusal plane is parallel with the floor (Fig. 18). This is determined by tracing an imaginary line from the ala of the nose to the tragus of the ear and making it parallel with the floor. This step is important, as any deviation can cause con-

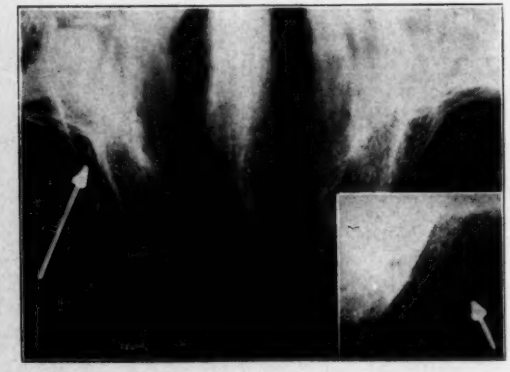

Fig. 9.—Foreign body (broken broach) retained in maxillary left bicuspid region (arrows)

siderable distortion of the normal landmarks in the roentgenogram. Such distortion can make interpretation not only more difficult, if not impossible, but it can also make localization of a root and its subsequent removal a much more difficult operation. It is also important that the sagittal plane be perpendicular to the floor,

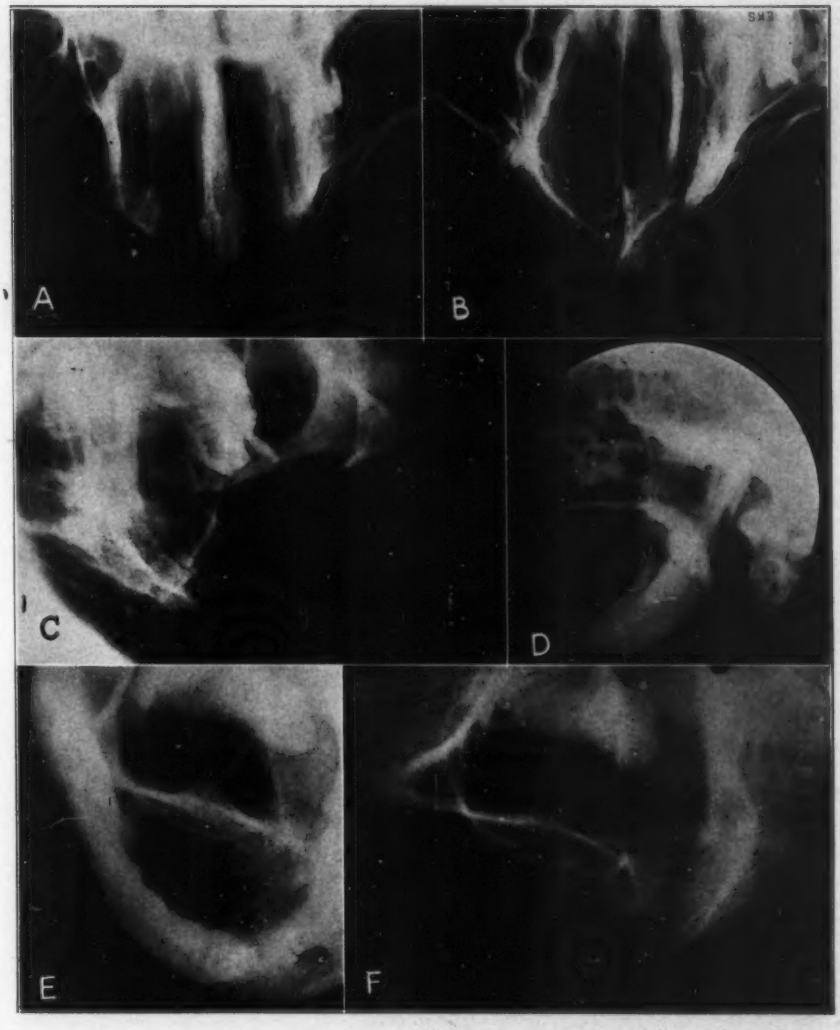

Fig. 10.—A, B and C: Routine occlusal roentgenograms of radiopaque body in right maxillary sinus. D: Direct lateral view of same case, affording vertical view of radiopaque body. A piece of impression paste had been forced into antrum when impression was taken immediately after extraction of molars. E and F: Impression paste in antrum

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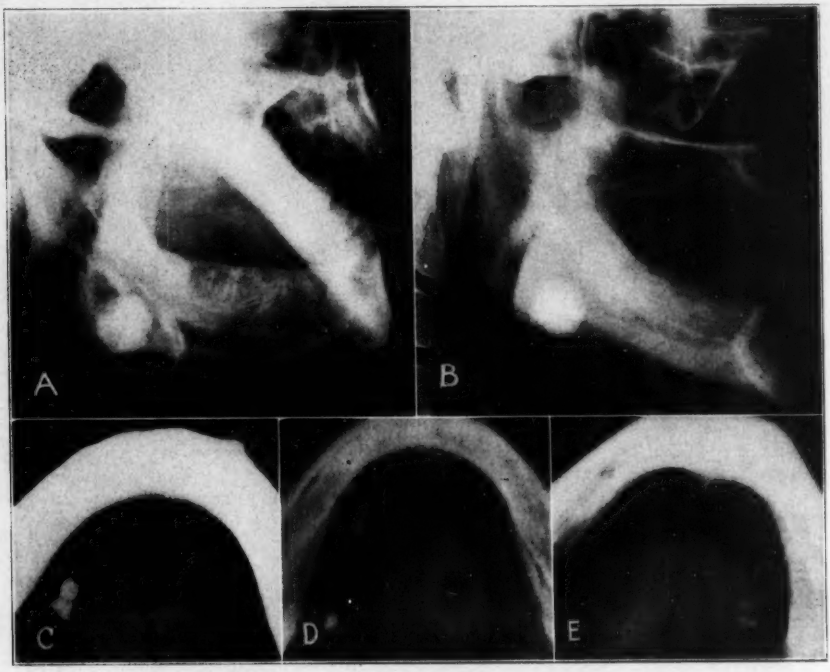

Fig. 11.—A and B: Large calculus lying near submaxillary gland. Patient "couldn't use lower denture" owing to periodic swelling in floor of mouth. C and D: Calculi in left Wharton's duct. E: Calculi in right Wharton's duct

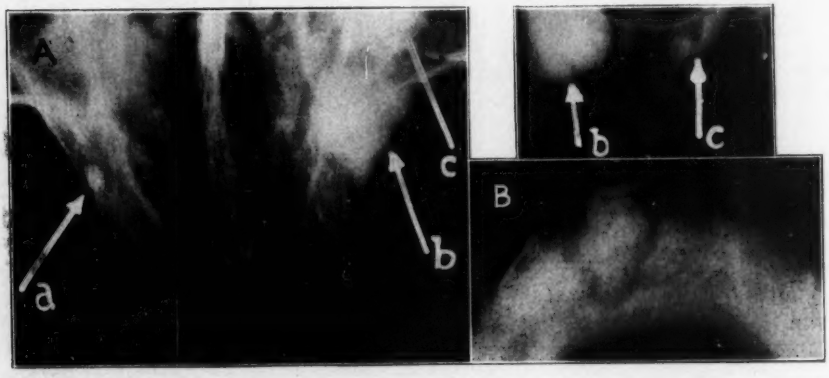

Fig. 12.—A: Occlusal roentgenogram of odontomata (b and c) and residual root tip (a). Periapical view (right) shows same odontomata (b and c). B: "Cystic odontoma" in mandibular left incisor region. Radiolucent outline is not cystic fluid, but fibrous tissue

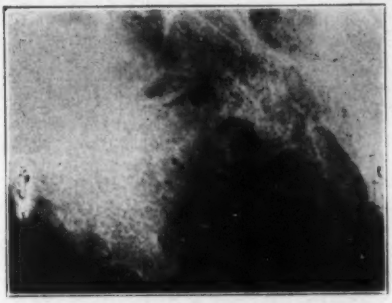

Fig. 13.—Sequestrums

not only for the occlusal, but for all the intraoral roentgenograms as well.

With the patient's head in the proper position, the occlusal film is inserted in the mouth sideways, with the long axis of the oblong film at right angles to the sagittal plane. The film is placed to include more of the third molar and tuberosity regions than would be possible if placed lengthwise. The patient is instructed to close and his index finger is placed on the anterior edge of the packet with enough pressure to prevent the film from slipping out, but not enough to bend it (Fig. 18).

If the patient has a lower denture, additional stability of the packet can be obtained if the denture is inserted and the patient instructed to close. If a lower denture is not available and the patient cannot hold the film properly by closing, he may use his thumbs, exerting upward pressure against the right and left ridges in the bicuspid regions (Fig. 18).

The cone is now adjusted to a vertical angulation of 65 degrees, with the central rays parallel to the sagittal plane. The point of entry is at the bridge of the nose, and the central rays must enter below the supraorbital ridge. Should the rays enter higher than the bridge of the nose, a dense, radiopaque shadow of the supraorbital ridge will appear across the middle of the roentgenogram.

A seven second exposure is necessary with the regular occlusal film (single emulsion). This slow film is highly recommended; it is far superior to the results

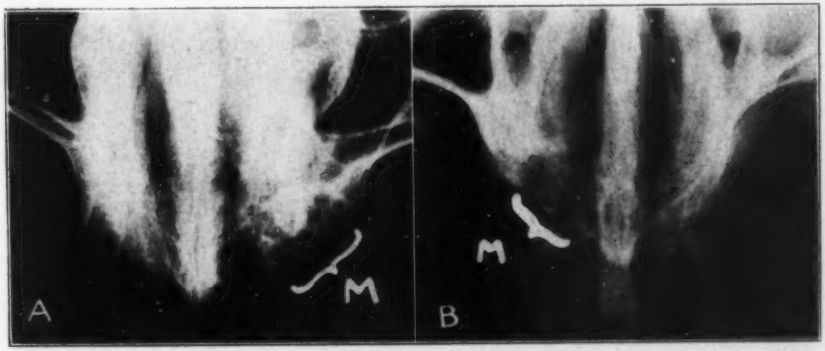

Fig. 14.—A: Punched out, "motheaten" appearance of bone (M) which prompted request for biopsy. Biopsy report was positive for malignancy. B: Irregular "motheaten" area of bone (M). Suspicion of malignancy was aroused because the area did not have appearance of a granuloma, cyst or of an active, diffused, suppurative condition. Request for biopsy resulted in a positive report for malignancy. (See Fig. 3B)

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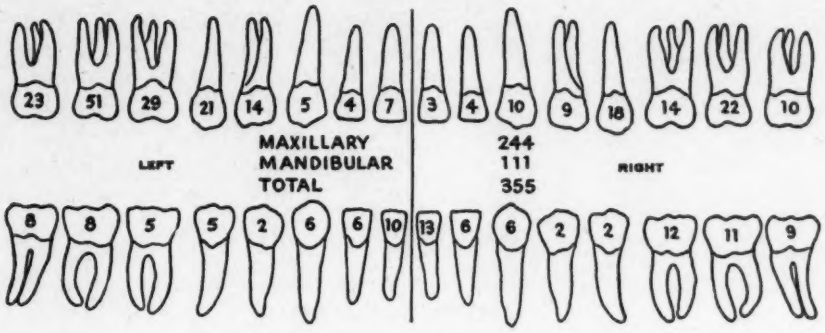

Fig. 15.—Situation of retained roots

that can be obtained with radiatized occlusal film.

The periapical roentgenograms of the maxillary right and left molar regions are taken in the usual manner. This technic often must be modified, however, to eliminate the shadow of the malar process. The Le Master technic is used to accomplish this; a cotton roll is placed between the ridge and the lower border of the packet, thereby causing the packet to assume a more nearly perpendicular plane, permitting the use of a decreased vertical angle of the tube. The shadow of the malar process then appears above the molar root areas in the film. Another means of obtaining this result is to grip the film in the beaks of a pair of hemostats, placing the film as nearly perpendicular to the floor as possible and having the patient close on the hemostats (Fig. 19). A piece of rubber tubing around the hemostats makes it easier for the patient to hold them rigidly.

The mandibular occlusal film technic is as follows: the chair and the headrest are tipped back so that the patient's oc-

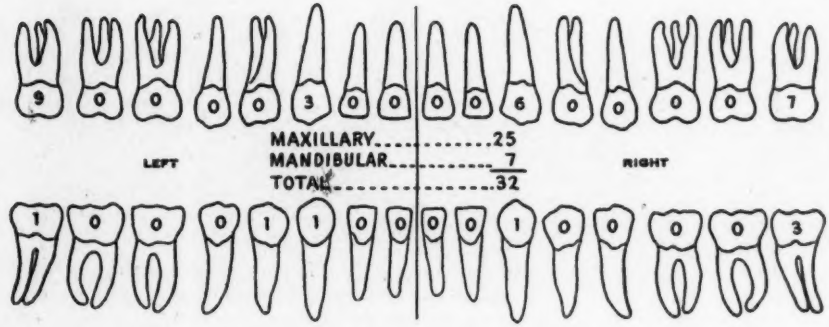

Fig. 16.—Situation of unerupted teeth

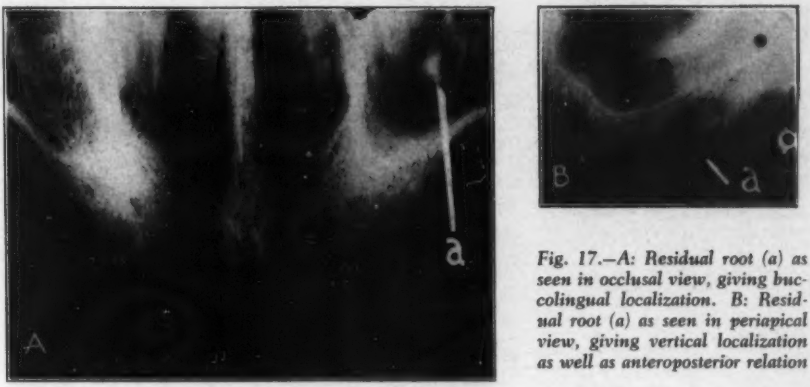

Fig. 17.—A: Residual root (a) as seen in occlusal view, giving buccolingual localization. B: Residual root (a) as seen in periapical view, giving vertical localization as well as anteroposterior relation

clusal plane is perpendicular to the floor (Fig. 20). The occlusal film is placed in the mouth sideways and as far back as possible, and the patient is instructed to close and to place the index finger on the front edge of the packet to prevent slipping. The vertical angle is 0 degrees with the central rays parallel to the sagittal plane. The point of entry is about 1 inch below the symphysis, in the middle of the soft tissue triangle of the floor of the mouth (Fig. 20). A seven second exposure is again used with the regular film.

Periapical films of the mandibular right and left third molar and anterior regions are then taken to complete the initial routine roentgenographic examination.

Should a root fragment be observed, for instance, in the maxillary bicuspid region, the next step is to take a periapical

Fig. 18.—Left: Maxillary occlusal film technic. Center: Patient's index finger placed against anterior edge of film packet for stability. Right: Stability of film packet maintained by thumbs

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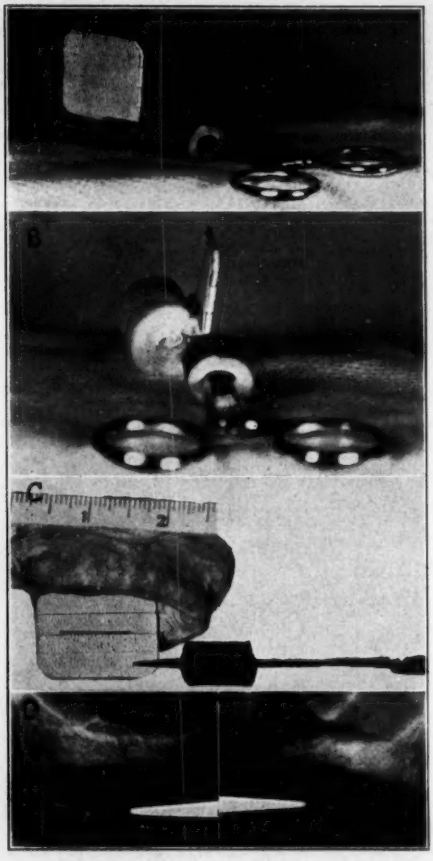

Fig. 19.—A: Use of hemostats to eliminate shadow of malar process. B: Modification of Le Master's technic for prevention of shadow of malar process. C: Use of hemostats, with indelible pencil mark on ridge at anterior border of film packet. D: Periapical films taken with aid of hemostats. (Left, malar process completely eliminated; right malar process evident)

roentgenogram of that region to give detail and localization. After the film is placed in the mouth, an indelible pencil mark is made on the crest of the ridge at the anterior border of the film packet (Fig. 21). The film is then developed, and the distance from the root tip to the anterior border of the film is measured with a millimeter ruler on the film. This distance then is measured in the mouth posteriorly from the indelible pencil mark on the tissues, thus giving exact anteroposterior localization. The original occlusal roentgenogram gives the buccolingual position of the root, so that it is localized in two planes and is ready for removal.

The question arises as to whether or not all root fragments should be removed. Smith[9] stated: "It stands to reason that a broken-off root tip, having been exposed to the mouth fluids at some time and having retained, as it probably did, a fragment of nerve tissue, is a potential area of infection. . . . As such, it seems advisable that they be removed before dentures are placed over them." Gardner and Stafne[5] merely stated that all of the 59 roots found in their series were removed.

Molt[8] felt that "all broken-off root fragments should be removed if they may be approached without too great a sacrifice of overlying tooth structures. . . . Many of these have no pathologic aspect and perhaps never may; but as the roentgenogram cannot be the index of this, the only safe procedure is their elimination where possible." Concerning the removal of impacted teeth, Molt stated: "If it is a probability or an actuality that the dentures may or do rest upon such teeth, their removal is indicated."

We also feel that all residual roots should be removed, except in such cases where "the cure is worse than the disease." The age and physical condition of the patient, the size and depth of the root fragment and the presence or absence of rarefied areas associated with it are all factors

Fig. 20.
Mandibular occlusal film technic

to be taken into consideration. In cases where it is deemed advisable not to try to remove the root or fragment, the fact should be noted in the records and the patient advised of its presence and the reasons for such a decision.

■ *Summary*

1. Edentulous regions should be roentgenographed because they would not be edentulous unless there had been infection or trauma at some time.

2. The information gathered by numerous investigators has shown the presence of many residual roots, unerupted teeth, cysts, foreign bodies and residual areas of infection, running the gamut from simple granulomas to malignancies.

3. Restorations in all cases should not be made without proper roentgenographic examination of edentulous areas and removal of residual roots and infection, except in a few cases where the trauma involved would contraindicate their removal.

4. The use of occlusal roentgenograms is recommended as part of the routine examination.—*4001 Spruce Street.*

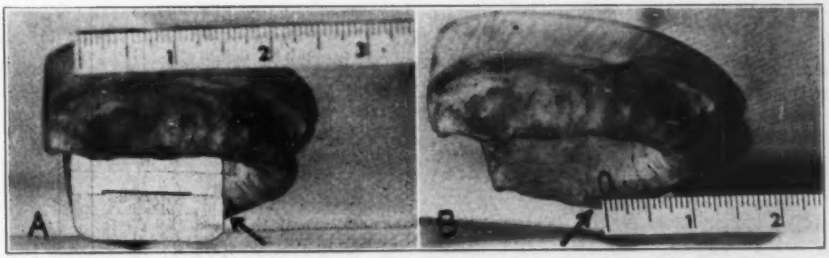

Fig. 21.—A: Indelible pencil mark (arrow) made on ridge at anterior border of film packet. B: Position of root (arrow) determined by measuring distance of root from anterior edge of film, then transferring this measurement to the mouth

Surgical preparation of the mouth

■ *Frederick F. Molt, D.D.S., Seattle*

It is generally believed that the "surgical" preparation of the alveolar ridges for the reception of dentures is a development of the last three decades only. Unquestionably, the procedure known as alveolectomy has become accepted and generally used during this period, but it is interesting to find that, like many "new" methods, similar technics were suggested and used many years before. The following excerpts have been quoted before, but it is worth while repeating what some of our predecessors advocated many years ago.

■ *Nineteenth Century Procedures*

In *Dental News Letter* for July, 1853, A. T. Willard,[1] of Chelsea, Mass., says:

After extracting the teeth I clip off all the mucous tissue that filled the space between the necks of the teeth, leaving a smooth border. I then dissect back the fibrous-mucous tissue from the alveolar wall or border about one-fourth of an inch and cut off with a pair of bone forceps the alveolar edge from a fourth to three-eighths of an inch deep; this will allow the edges of the mucous tissue to come together, having the appearance of a cut only around the dental arch. . . . I believe that I have saved the patients much suffering and much inflammation and also Nature the task of removing this same matter by absorption or effusion. By this process . . . (the gums) sooner become hard and firm. . . . We can save four months' time in fitting the gums for a permanent set of teeth. . . . But [he sagely adds] the difference in age, health and number of teeth to be removed should be the criterion for our government under this operation.

From that date on there were occasional references to similar procedures in the periodicals. In 1876, W. George Beers,[2, 3] of Montreal, presented, before the New York Odontological Society, the following on "Excision of Alveolus After Extraction of Teeth":

In the *Canada Journal of Dental Science* I described an important case of this kind and the ultimate victory over Nature in modeling into a regular and even arch one of the best imitations of a horse-shoe that I ever saw behind human lips. Since this "heroic treatment" (as such operations have been called) I have made a common practice of removing with a cutting forceps, large portions of the transverse processes or septa, and the outer and inner plates of the alveolus, especially where the lip is naturally short, the gums and alveolus unnaturally prominent and the prospect is presented that several months' absorption will make the case what otherwise it could not have been—one suitable for gum teeth. After the extraction of the incisors, cuspids, and bicuspids, cut cleanly across the gum down to the process, as far as you propose to excise; then slip your knife under and dissect away in one piece. The excision can then be proceeded with, *taking care to remove all you cut.* [Italics mine.]

Read at the thirtieth annual meeting of the American Society of Oral Surgeons, Chicago, September 11, 1948.

1. Willard, A. T., Preparing the Mouth for Full Sets of Artificial Teeth. *D. News Letter* 6:238 (July) 1853.
2. Beers, W. G., Notes from Practice. *D. Cosmos* 18:118 (Feb.) 1876.
3. Beers, W. G., Notes from Practice. *Missouri D. J.* 8:294 (Aug.) 1876.

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George Bernard Shaw said that "every orthodoxy was once a heresy" and how truly this applies to the present day technic of mouth preparation! Many arduous years went by as the forward looking group in the profession fought for a departure from the orthodox "tooth pulling" with its laceration and residual roots and debris. Meanwhile, those who made dentures struggled, with what ingenuity they could muster, to fit them to mouths ill adapted for their construction and wear. Methods were suggested for sectional impressions and other devices to overcome obstacles. The "open gum" for a too prominent anterior maxillary ridge is only one example.

■ *Background of Modern Alveolectomy*

Several factors undoubtedly have contributed to the advancement of more effectual preparation for denture construction; more satisfactory general anesthesia through the admixture of oxygen with nitrous oxide; the development of surgical asepsis; the utilization of the roentgen ray in dentistry; the promulgation of focal infection knowledge and its demands for thorough removal of potential foci; the introduction of synthetic local anesthetic agents and nerve blocking anesthesia; and, as well, the more scientific approach to the problems of denture construction.

Strangely, but as in so many other departures from long accepted methods, the attitude of the dental school teachers themselves was antagonistic in the extreme. The men who advocated surgery instead of tooth pulling were labeled "radical" or worse. Any reference during a dental meeting to "surgical removal of teeth" was sure to produce derisive smirks from the greater part of the audience. A comment by an oral surgeon of ability and note that "it isn't necessary to remove all the bone from the clavicle to the eyebrow to extract a tooth" is absurdly exaggerated, of course, but a fair sample of the ridicule heaped on the effort to modify and improve the established yet antiquated, inadequate methods.

As the quotations from earlier dental literature demonstrate, those who fought the battle in the second decade of this century were not actually pioneers, yet what was advocated was quite as new to the profession as if it never had been thought of. There ensued an acrimonious controversy between Shearer[4] and Novitsky[5, 6] over who had originated the procedure. But this died of inanition as did, gradually, the antagonism of the ultraconservative element of the profession. Shearer called his operation "external alveolectomy," although he extended his reduction to both alveolar plates. Novitsky called it "surgical removal." The term "alveolotomy" was put forth; Smith suggested "alveolomerotomy." But finally "alveolectomy" became the accepted designation. When Gardner,[7] in the newly established dental section at the Mayo Clinic, abandoned nitrous oxide-oxygen anesthesia, "tooth pulling" and blind curettage for block anesthesia and "open view" procedures, the battle began to be won. The schools began to recognize, even to advocate and teach, the procedure,

4. Shearer, W. L., External Alveolectomy. *Nebraska D. A. J.* 7:499, 1920.

5. Novitsky, Josef, Notes on Radiographs and the Surgical Treatment of Septic Teeth and Alveolar Process. *Panama-Pacific D. Cong.* 2:548, 1915.

6. Novitsky, Josef, Shearer's Procedure for the Removal of Dead Teeth and Their Pathological Products, Described in 1920, Is Identical with Novitsky's Method for the Same Purpose, Described in 1915. *J. D. Res.* 3:307 (Sept.) 1921; Shearer's reply, 309; Novitsky's response, 313.

7. Gardner, B. S., Preparation of the Mouth for the Prosthetist from the Surgical Standpoint. *J.A.D.A.* 10:64 (Jan.) 1923.

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and articles originating in all parts of the country testified to the general acceptance of the principles involved.

What were the objectives? Complete surgery, of course, in the removal of teeth and infectious foci, but more. I quote from a paper I presented in 1923, a quarter of a century ago[8]:

> By anticipating in our surgical preparation, as nearly as it may be approximated, the eventual absorption of the labio-buccal plate, the insertion of a stable, comfortable and practically permanent denture is made possible; stable because a solid foundation is provided for the adaptation of the denture; comfortable because all points and edges of process are obliterated; and permanent because although the denture may at some time require re-adaptation in a minor degree this does not necessitate reconstruction.
>
> Add to this the esthetic possibilities contingent upon providing for proper ridge-lap, and the advantage to be gained by an immediate restoration to normal function and appearance and we have profited . . . greatly.

In the same paper it is stated (and I have had no occasion to alter my procedures perceptibly):

> In a generalized way we may segregate our alveolectomy cases into three surgical groups:
>
> I. Those cases requiring process reduction alone, including completely dentulous or partly edentulous cases, and those edentulous cases in which simple extraction procedure has failed to provide the requisite result. This classification would include, as well, those prognathous and orthognathous cases in which we endeavor to improve the appearance of the patient. . . . There should be no difference in the surgical care and aseptic precautions from those of the most complicated type and that means meticulous attention to every detail. In my personal opinion the use of stones and burs for rounding off bony structure has no place in our surgical procedure. . . . By the use of rongeurs, mallet and chisel, files and alveolar trimmers all undercuts are eliminated, tuberosities reduced and the labio-buccal margins sufficiently cut away to provide for the requisite ridge-lap and the proper approximation of mandibular and maxillary teeth. . . .
>
> In all cases the degree of reduction necessary should be predetermined by the study of models, if possible, and in consultation with the prosthetist or practitioner who is to do the restorative work. In this way we may avoid those unfortunate results of too diligent surgery occasionally encountered in which no judgment, either surgical or otherwise, has apparently been used and which, because of the difficulty of restoring them to masticatory efficiency, have been held up in vituperative condemnation by those opposed, as exemplifying the entire procedure.
>
> II. Those cases of "pyorrhea" involvement of either the condensing or rarefying osteitis type. . . . In these cases all hypertrophied gingival tissue should be removed as its retention will menace the success of the denture, causing excessive and continued absorption.
>
> We frequently find extensive absorption of the inner plate of bone with the outer plate remaining as thin as a knife edge. Following simple extraction procedure these cases frequently present a most encouraging aspect with the hypertrophied tissue supported by this precarious prop, but the discomfort and rapid absorption after denture construction is extreme. With alveolectomy the removal of this knife-edged bone and the diseased tissue leaves a ridge so flat as to be in marked contrast with the other but a stable result.
>
> III. The most diversified, . . . (group) calling for all degrees of process reduction but with periapical lesions of various sorts, the removal of which is imperative. . . . The proximity of pathologic areas to such vital structures as antrum, palatine foramina, mental foramen and inferior dental canal, should be carefully noted and their invasion avoided.
>
> In all cases as much of the septum as is consistent with the desired shape of the ridge should be retained to act as a matrix in bone regeneration. The lingual plate is left untouched except for smoothing. No tension should be put

8. Molt, F. F., The Anesthetic and Surgical Problems in Alveolectomy. *D. Summary* 45:854 (Oct.) 1923.

on the flaps as they are drawn together nor should they be over-sutured. Absolute coaptation is not desirable and an effort to close the wound entirely means either too extensive process reduction in the molar areas or tension upon the buccal flap that will lower the buccal fold and militate against successful denture construction. All sutures should be placed over septa where possible. A space of two millimeters left between the flaps will provide adequate drainage for hemorrhage and avoid, in most cases, ecchymosis. . . .

Substitute "resorption" for "absorption" and the description of technic and objectives might well have been written at the present moment.

■ *Surgical Technic*

Technical points in the operative procedure involve the making of the incision at the gingival margin, or, in cases of extreme pyorrhea destruction, above or below the hypertrophied tissue, and the careful elevation and retraction of the mucoperiosteal flap (Fig. 1, left). Whether process reduction precedes or follows the extractions depends a great deal on the condition of the teeth, the quality of the bone and the existence of periapical pathologic areas. The preliminary removal of some outer plate or process will expedite the removal of broken down, brittle or malformed teeth and frequently will preserve the septums, which is important (Fig. 1, right).

After the desired shaping of the ridge, frequently there will be, because of the reduced arc, a surplus of tissue. If frenectomy is required, this is then carried to the median line. If the frenum is not to be disturbed, the superfluous tissue is reduced by removing a *V* over the septum between cuspid and bicuspid (Fig. 2). Muscle strands that will interfere with the retention of the denture are readily snipped, and the diamond-shaped openings are closed with transverse sutures. Only enough sutures are used to retain the flap; these are of the interrupted type rather than continuous. It is not necessary, in fact it is distinctly a disadvantage, to "buttonhole" the flaps.

The plethora of articles presented by both oral surgeons and prosthodontists from 1923 to 1938 seems to be in general agreement. Dean,[9] in 1936, offered a variant from the trimming of the outer alveolar plate in his "intraseptal alveolotomy." This comprehends the removal of a *V*-shaped portion from each interdental septum, the collapse of the outer plate after fracturing it with the chisel, thus producing a greenstick fracture, then moulding and suturing the fragments into place. He stated that when portions are missing, or, presumably, removed with the teeth, they are transferred to their erstwhile or other desired location.

Freeman[10] grudgingly conceded that surgical preparation has its place but deprecates the use of sutures from labiobuccal to lingual aspects. He also contends that there is no occasion for the removal of periapical granulomata or abscesses inasmuch as they are, he says, "repair tissue" and not pathologic. He also decries excessive effort toward asepsis. House,[11] Campbell,[12] LaDue,[13] Crawford,[14] Sears,[15]

9. Dean, O. T., Surgery for the Denture Patient. *J.A.D.A.* 23:2124 (Nov.) 1936.

10. Freeman, C. W., The Extraction of Teeth. *J.A.D.A.* 17:1793 (Oct.) 1930.

11. House, M. M., The Status of Mouth Preparation for Denture Construction. *J.A.D.A.* 14:2022 (Nov.) 1927.

12. Campbell, D. D., Some Fundamental Factors in the Construction of Efficient Dentures. *J. D. Res.* 7:127 (June) 1927.

13. LaDue, J. B., Preparation of Mouths for Artificial Dentures. *Illinois D. Soc. Tr.*, 1926, p. 361.

14. Crawford, J. W., Ideal Preparation of the Alveolar Process Before Denture Construction. *J.A.D.A.* 13:361 (March) 1926.

15. Sears, V. H., Indications for and Limitations of Alveolectomy, with an Original Means of Control. *D. Cosmos* 68:1187 (Dec.) 1926.

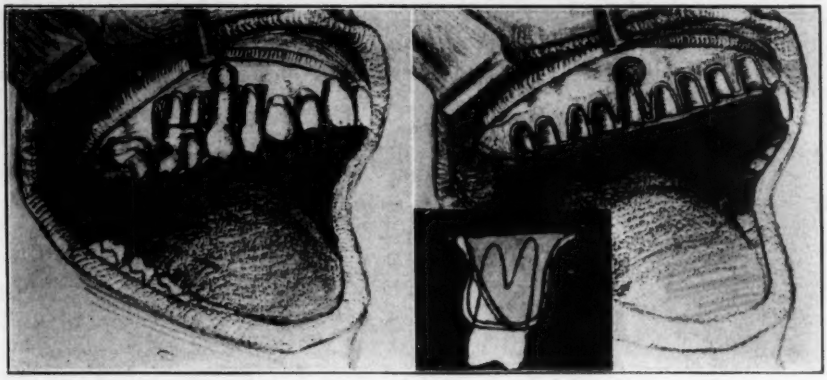

Fig. 1.—Left: Mucoperiosteal flap retracted; section of buccal plate removed to expedite extractions; periapical abscess exposed for positive curettage with direct vision. Right: Extractions and preparation completed in quadrant; periapical mass extirpated; septums shaped for ridge-lap of denture teeth as shown in cross section

Gillis[16] and others among the prosthodontists have offered their individual conceptions of what constitutes an ideal ridge, but as a group these specialists are not yet in complete accord on the subject.

Campbell's often-quoted statement that he had the first mouth yet to examine from which teeth and sufficient process have been removed properly by other than surgical removal, itself gave a great stimulus to the reception of alveolectomy.

More recently, Schram,[17] Claflin[18] and Svoboda[19] have given reports of their individual studies on bone repair following alveolectomy which indicate completely satisfactory healing and bone regeneration —a point on which skepticism had existed.

■ *Trials at Naval Training Center*

An unusual opportunity was afforded us during the recent war to observe mass results of the extractions and mouth preparations performed for Naval trainees at the Great Lakes Naval Training Center. When the long-standing dental requirements for qualification were given "the deep six" and anyone within draft age who had two jaws was accepted, the problem of dental rehabilitation within the eight week training period required concerted action.

SUBJECTS—Recruits who, upon examination, were classified as denture subjects (either complete or partial) were assigned to designated companies, kept together in barracks and launched at once on the necessary extractions. Work was done on one quadrant at a sitting. No patient was operated on who showed an elevated temperature. The patients were all cared for in one dispensary unit and the lads turned into the adjacent sick-bay for twenty-four hours of postoperative care, or

16. Gillis, R. R., What Should the Prosthodontist Expect from the Exodontist? *J.A.D.A.* 17:1334 (July) 1930.

17. Schram, W. R., A Histologic Study of Repair in Maxillary Bones Following Surgery. *J.A.D.A.* 16:1987 (Nov.) 1929.

18. Claflin, R. S., Experimental Alveolectomy. *J.A.D.A.* 24:1433 (Sept.) 1937.

19. Svoboda, J. F., Clinical Study of Repair of Bone After Alveolectomy. *J. Oral Surg.* 5:91 (April) 1947.

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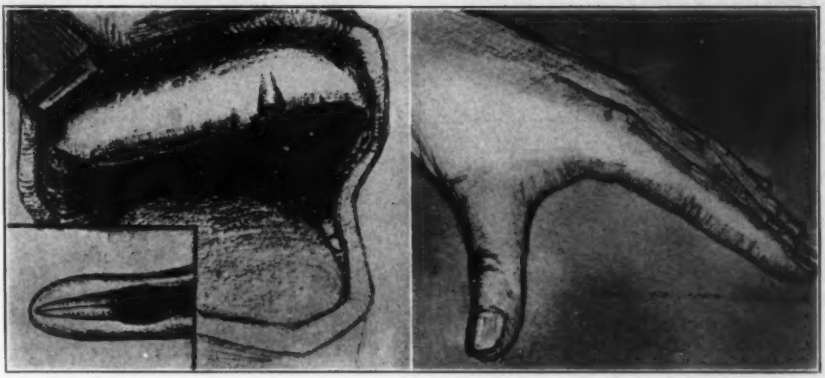

Fig. 2.—Left: Mucoperiosteum replaced and sutured over septums; tuberosity reduced by removal of "V" of tissue; excess of flap tissue carried to septum between cuspid and bicuspid to be removed and cross suture placed. Right: Crotch of extended hand illustrates ideal modified-U shaping of ridge to provide for ridge-lap of denture teeth

longer if there was evidence of a rising temperature. The mess hall for these recruits served a special menu adapted to their edentulous needs. The "Toothless Tigers," as they immediately designated themselves, showed a remarkable morale as well as marked interest in their training.

No complete totals are available for the work, but when the program was in full swing, 3,142 men prepared for dentures comprised a single month's totals. Although the 18 year old group predominated, ages ranged from 15 to 45, thus providing an excellent cross section for observation of methods and of results. Aseptic procedures were imperative and gratifying—of the hundreds of thousands of extractions during the 1942-1945 period there was not one serious postoperative infection.

OPERATORS—For this dispensary, doing the extraction for dentures, an effort was made to select the junior officers who had had special training or had shown marked facility in extraction procedures. But there had to be a constant watch to avoid the tendency on the part of these operators to produce "pretty" cases with all tissues in coaptation, frequently at the expense of over-reduction and of tension on the buccal flap, rather than to study the needs of the individual. The operators constantly had to be reminded that the indications for an 18 year old with hypocalcemic bone were not by any means identical with those for the 45 year old. One observation made was that the young officer who considered himself an oral surgeon and had had, perhaps, special training in that work, although very little general practice, was more inclined to "over-surgerize" than was the man who in practice had prepared ridges for his own denture product. These men seemed more conservatively inclined.

Among other things, it was emphasized that completely unerupted, submerged or impacted third molars in these denture cases were not to be disturbed but,

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in order to preserve the tuberosities and posterior mandibular ridges, were allowed to remain for later eruption under the dentures. This was explained in each case; but undoubtedly the procedure was questioned and probably criticized by many of the dental officers subsequently called on to remove these teeth when they did erupt. However, comparison of cases proved without question that this was a wise restriction.

■ *Calcification*

It was found, incidentally, that the time allotted for surgery, healing and insertion of dentures was vastly inadequate and that well-fitting dentures at Great Lakes could be hopelessly loose by the time the recruit was ready to ship out.

McKevitt's[20, 21] general classification of bone characteristics, dividing them into normal, hypo- and hypercalcified, has particular application to the grouping of prospective denture patients, and it is by no means entirely a question of age. In the postoperative observation of cases, it is seen that those hypocalcemic jaws frequently resorb at a rapid rate. By a study of preoperative roentgenograms, it should be possible to determine this prospect and at least prepare the patient for the necessity for frequent rebasing of the denture. A minimal amount of reduction is indicated in these cases in contrast with the hypercalcemic case in which very extensive reduction may be done, if necessary, with impunity. The amount and rapidity of resorption cannot be estimated nor directed, but certainly the surgical preparation of the ridges is no factor.

It would be impossible to theorize on its significance, but my observation has been that by far the larger proportion of denture patients with hypertrophied and excessively resorbed ridges are women. Certainly, too, the failure to take away the hypertrophied pyorrhea-pocket tissue contributes to excessive resorption.

■ *Abnormal Conditions*

The need for preserving tuberosities in the younger groups by postponing extraction of unerupted teeth has been discussed. However, many patients have such over-large tuberosities as to preclude the satisfactory construction of the denture or its insertion if it were constructed. These tuberosities may be either of the fibrous tissue or of the bulbous, bony type. The fibrous tuberosity is reduced by removing a wedge-shaped section either at the crest or buccally, undermining the tissue on each side to collapse it and then suturing. The bulbous, bony structure may be difficult to care for as, more frequently than not, it consists of a thin compact bone wall enclosing "mushy," almost fluid osseous content. If the outer bony wall is removed completely to eliminate undercuts and to parallel the two sides, there may be little tuberosity left. Miller[22] and Osterloh[23] in California, state that they have found these mushy tuberosities to be cesspools of septic material and claim some remarkable benefits to patients from the elimination of this content. Articulated models provide the most desirable evidence of the need for, and extent of, this reduction. Tuberosities that will not

20. McKevitt, F. H., Atrophy and Hypertrophy of Maxillary and Mandibular Alveolar Process and Their Effect on Stability of Artificial Dentures. *J.A.D.A.* 19:424 (March) 1932.

21. McKevitt, F. H., Osseous Changes in the Alveolar Process and Their Effect on Partial Dentures. *J.A.D.A.* 23:2241 (Dec.) 1936.

22. Miller, H. E., personal communications.

23. Osterloh, J. P., personal communications.

Fig. 3.—Left: Example of extreme prospective denture case in which preparation by alveolectomy is imperative. Center: Bulbous tuberosities calling for reduction before successful denture construction can be effected. Right: Large torus palatinus which requires reduction; right tuberosity and anterior regions also should be reduced

conflict with the mandible themselves may do so when denture material is interposed (Fig. 3).

Other abnormal conditions susceptible to correction are the exostoses frequently found at the midline of the palate, on the buccal and labial surfaces of either maxillary or mandibular ridge or the lingual surface of the mandible (Figs. 3 and 4). The torus palatinus is occasionally very extensive but is susceptible to reduction to allow normal denture construction. After exposing the mass by a midline incision and with extremely careful retraction of the thin overlying tissue, it is advisable to remove the bone in rather thin layers by chisel. Occasionally honeycombing the mass with a surgical drill will expedite the removal.

The final smoothing of the surface may be done advantageously with a large surgical bur if the tissue is protected from laceration. The tori on the outer aspect of the maxilla and mandible are readily exposed and removed, using a chisel with the bevel out. This same procedure is

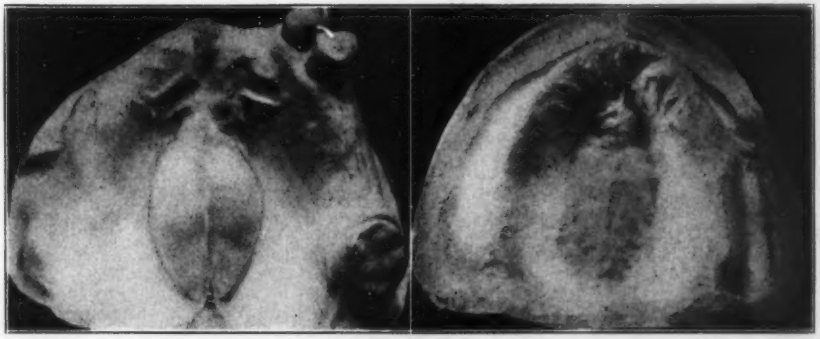

Fig. 4.—Left: Extremely large torus palatinus. Right: Maxilla after reduction of torus and ridge preparation

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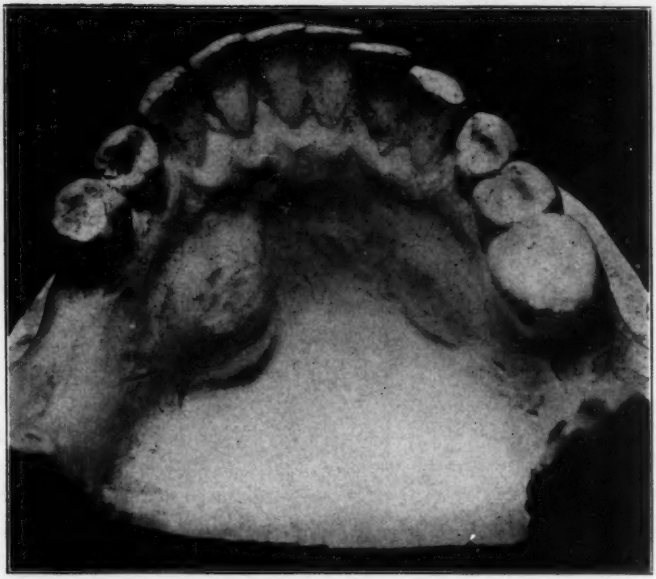

Fig. 5.—Lingual tori requiring reduction before either full or partial denture can be constructed

used for the lingual tori (Fig. 5) on the mandible; but it is advisable, after retracting the mucoperiosteum, to hold a broad periosteal elevator tightly against the mandible below the torus to avoid the possibility of its falling when detached by the chisel cut. When these buccal and lingual exostoses are encountered in an already edentulous and healed mouth, approach is made through a semilunar incision instead of incising at the ridge crest.

Hypertrophied tissue flaps (epulis fissuratum) may be removed either with scalpel or electrosurgery, according to the individual case. Either method may offer the possibility of deepening the labial sulcus, which will usually be advantageous. If the condition is accompanied by the presence of a serrated, knife-edged ridge, as is so frequently found in the mouths of patients who have had rapid and marked resorption, it will be desirable to expose this and reduce it to a smooth surface.

The mylohyoid ridge is frequently knife-sharp and prominent, particularly in cases where there has been extremely advanced periodontoclasia. With careful retraction of the lingual mucoperiosteum to expose this ridge and care not to "lose" any portion detached, such a prominence may be reduced markedly so that it will allow a comfortable lingual flange on the denture which otherwise would be unbearable. When hypertrophied tissue flaps have been removed or this ridge has been reduced, in the case of a patient already wearing dentures, it is an advantage to add

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modeling compound to the denture to act as a stent.

Although there is always a question of the possibility of maintaining a strictly aseptic regime in intraoral surgery, no lack of effort toward that end is pardonable. The use of the present day antibiotics may remedy unavoidable breaks, but they should not be leaned upon. In cases in which there is an apparent tendency to bleed excessively, the use of wisps of oxidized cellulose in the individual sockets will hasten coagulation, militate against swelling and ecchymosis and hasten the "settling down" of the ridges. This has proved particularly expedient in the insertion of "immediate" dentures in which the posterior teeth previously have been extracted.

■ *Summary*

1. Alveolectomy as a preparation for denture construction is not entirely an operation of recent years. Similar procedures were advocated in the middle of the last century.

2. With the refinements in anesthesia, surgical asepsis and other facilities, such mouth preparation now has become routine. Besides aiding in the scientific replacement of the natural teeth it makes possible the complete removal of debris and septic material and, where necessary, the removal of abnormal or excessive osseous structure.

3. The degree of indicated process reduction differs with age and with osseous calcification as determined by the roentgenogram.

4. Careful handling of tissue, avoidance of tension on tissue flaps and the maintenance of as complete surgical asepsis as possible are urgent.—728 *Medical and Dental Building.*

■ American Academy of Oral Pathology

The American Academy of Oral Pathology will hold its Third Annual Meeting on Sunday, February 6, 1949, at the Hotel Stevens, Chicago. The meeting will begin promptly at 9:00 a.m. and ample time will be allowed for discussion of the papers. The entire program has been arranged so as to be of maximum interest to those concerned with oral diseases.

On Sunday evening the Academy will hold its banquet at the Hotel Stevens in Private Dining Room No. 2. Dr. Robert A. Moore, Dean of the School of Medicine and Professor of Pathology, Washington University, St. Louis, Missouri, will be the speaker. All Fellows, members, their wives and guests are cordially invited to attend. Reservations may be made at the registration desk.

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Pharmacology of the newer synthetic analgesics

■ *M. H. Seevers, Ph.D., M.D., Ann Arbor, Mich.*

The great strides made during the last decade in the cure of infectious disease by modern chemotherapeutic methods have overshadowed comparable advances in less spectacular but no less important fields of medicine. One of these fields involves the relief of pain by the synthetic analgesics, that is, chemical compounds capable of producing relief of pain short of loss of consciousness. One of the principal reasons for outstanding advances in this field is that the organic chemist, the pharmacologist and the clinician have joined in a concerted, cooperative attack on the problem. Their approach has been especially advantageous in this field because of the subjective, hence ephemeral, nature of pain and the difficulties encountered in evaluating correctly the efficiency of potential analgesic compounds.

■ *Variability of Reactions*

These difficulties arise largely from the wide variability in reaction among individuals even to the same pain stimulus. There are, for example, differing responses in the "psychoneurotic" and the "stoic"; variations in response in the same individual from time to time with the ebb and flow of psychic and physical activity; and the difficulties associated with the study of pain in animals, where the only measure of effect is some objective response such as the cry, withdrawal, flight or some reflex muscular response. Many of these chemical compounds are unique in that they not only induce analgesia, but their prolonged use results in acquired tolerance, and psychic and physical dependence, the triad of factors ordinarily termed addiction.

■ *Morphine and Codeine Compounds*

Although German chemists always have been active in this field, it was not until 1930 that any distinctive advance was made. Prior to that time the physician was limited in his choice of analgesic agents to the salicylates (aspirin, etc.), the coal tar analgesics (acetophenetidin, antipyrine and the like), the naturally occurring derivatives of opium, such as morphine and codeine, and a few simple chemical modifications of the morphine molecule, such as heroin. The first interest in the problem naturally centered around modification of the morphine molecule because this was the only chemical substance known to possess significant activity as an analgesic agent. In 1930 German chemists prepared two ketone derivatives of morphine and codeine.

The morphine analogue, dihydromorphinone, known commercially as Dilaudid (Bilhuber-Knoll), was introduced into this country in 1932. Because it is a more potent compound than morphine, producing similar effects with smaller dosage, it

Read at the thirtieth annual meeting, American Society of Oral Surgeons, Chicago, September 9, 1948.

aroused considerable interest, particularly in view of the statement made concerning its lack of habit-forming properties. Subsequent clinical investigation indicated, however, that this compound possessed only minor advantages over morphine.

The codeine analogue, dihydrocodeinone, although known for a considerable time and exploited widely in Germany, has been made available in this country just within the past year as Dicodid (Bilhuber-Knoll) or Hycodan (Endo Products) and is advocated particularly for its antitussive effect.

Neither compound is capable of replacing morphine or codeine. They retain some of the principal disadvantages of these two substances, which include the production of mental sluggishness, irregularity of action after oral administration, a considerable incidence of unpleasant side actions, particularly nausea and vomiting, and the development of tolerance and addiction.

About twenty years ago a concerted attack on the whole problem of pain was initiated in this country under the auspices of the Committee on Drug Addiction of the National Research Council. It was the purpose of this organized effort to find analgesic compounds which did not possess the disadvantages of morphine and codeine. This program is still in effect at the National Institute of Health.

Hundreds of morphine derivatives have been made and examined pharmacologically in animals, in normal human subjects and in former morphine addicts. Although the original objective of this study has not yet been fulfilled, that is, the finding of a compound which is entirely free of addiction liability, certain substances have evolved which possess useful analgesic properties. Probably the most outstanding of this group is a methyl derivative of Dilaudid, methyldihydromorphinone. This new compound recently has been introduced into medical practice under the trade name of Metopon.

■ *Metopon*

Metopon has several advantages over morphine or Dilaudid, especially when used in the treatment of chronic pain. Being a more potent compound, the total quantity of the drug can be reduced and yet carry equal analgesic effectiveness. At the same time, there is a diminution in the sedative and euphoric actions of the drug, as well as the unpleasant emetic and intestinal side actions. This substance possesses another distinctive advantage over previously used opium derivatives: the oral dosage is approximately the same as the parenteral dose, indicating good intestinal absorption. This property is of particular value in the treatment of individuals with chronic intractable pain, since it obviates the necessity of hypodermic administration and greatly reduces nursing care.

In 1946 the Committee on Drug Addiction of the National Research Council recommended that this compound be distributed to certain physicians throughout the United States for the treatment of chronic pain of cancer with the objective of determining its relative efficiency in comparison with morphine and other commonly used opiates. It was made available only for one specific use—the treatment of chronic pain of terminal malignancy. This restriction was imposed in order to obtain sufficient data on one class of patients to make a worthwhile report. The drug now has been used in more than 5,000 patients with terminal malignancy.

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Data on 2,500 of these patients have been summarized by Dr. Nathan B. Eddy for the Committee.[1]

A summary of the data indicates that pain relief has been fair or better in about 75 per cent of all trials, and most patients obtain relief of pain without associated mental confusion or a tendency to sleep. This represents a distinct advantage over morphine and other commonly used opiates since mental clarity is not a usual feature of their action. Side actions were entirely absent in 90 per cent of all users, nausea being the most common in the 10 per cent who experienced unpleasant symptoms.

The effectiveness of this drug is much greater in individuals who have not been subjected previously to the use of morphine or other opiates because of the crossed tolerance which always develops between morphine derivatives. In individuals who have not had morphine or any other opiate previously, relatively little tolerance to Metopon is developed and patients can get along for many weeks without notable physical dependence on this drug. The recommended minimal dose of 6 mg. is not always adequate to bring about complete relief of pain and may be exceeded if necessary.

Obviously the use of the drug depends on close observation by the physician and would not be a drug of choice for hypodermic administration in competition with morphine or Dilaudid for purposes other than the treatment of chronic pain. In many instances it would be inferior to morphine, for example, in preoperative medication, where a sedative action usually is desired.

In the field of chronic pain, even in ambulatory or semiambulatory patients, this drug deserves trial. Restrictions to its use in cancer now have been, or soon will be, removed, and it may be considered for any condition where morphine previously was used with justification, recognizing that this drug is capable of inducing physical dependence and addiction even though the latter is not developed as easily or as rapidly as with morphine or Dilaudid.

The drug Dicodid, or Hycodan, is being recommended at present in this country principally for the relief of a cough. A number of reports are appearing in which it is being compared with codeine for this purpose. Although addiction to codeine is relatively rare, and in all likelihood the same would hold true for Dicodid, especially when used in small dosage for the relief of the cough, the German experience would indicate that the addiction potential of this compound is somewhat greater than codeine, especially if Dicodid is used as a morphine or codeine substitute for its general analgesic action.[2]

■ *Merperidine*

In 1939 Eisleb and Schaumann,[3] of the I. G. Farbenindustrie in Germany, who were searching for a new atropine substitute, observed that one of their compounds possessed definite analgesic properties in mice. This compound, originally introduced in Germany as Dolantin, is now sold under the trade name of Demerol (Winthrop Chemical Co.) in the

1. Eddy, N. B., Pharmacology of Metopon and Other New Analgesic Opium Derivatives. Ann. New York Acad. Sci. In press.

2. Krueger, Hugo, Eddy, N. B., and Sumwalt, Margaret, *The Pharmacology of the Opium Alkaloids*. Pub. Health Rep. Suppl. No. 165. U. S. Govt. Printing office, 1941.

3. Eisleb, O., and Schaumann, O., Dolantin, ein neuartiges Spasmolytikum und analgeticum (chemisches und pharmakologisches). *Deutsch. Med. Wchnschr.* 65:967 (June 16) 1939.

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United States and is variously designated as Pethidine (British), Isonipecaine (USP), and more recently as merperidine, the nonproprietary name assigned by the Council on Pharmacy and Chemistry of the American Medical Association.

The discovery of the analgesic properties of merperidine represents what now appears to be one of the turning points in the problem of the control of pain. Prior to this time, not much attention had been paid to that portion of the morphine molecule which involved the nitrogen-containing ring. By a stretch of the imagination, one can conceive of this nitrogen-containing ring as being related chemically to the piperidine nucleus which forms the basis of merperidine.

Initial clinical studies on Demerol were begun in this country about 1942. Six years have passed in which to evaluate the clinical effectiveness of merperidine.[4] On a basis of dosage, it generally is agreed that the drug has approximately one tenth the potency of morphine. This places it more or less in the same general category of codeine. It differs from codeine in one important respect. With codeine, the analgesic ceiling is reached with 60 mg. of the drug, and further increase in dosage prolongs but does not magnify the effect. With Demerol, the total effect is enhanced by increasing the dosage although the increment in analgesia is not directly proportionate to this increase, as is also the case with morphine. The ordinary dosage of 50 to 100 mg. administered parenterally is roughly equivalent to 5 to 10 mg. of morphine.

The duration of action of merperidine is somewhat shorter than morphine, usually producing dependable analgesia for approximately three hours as compared to four for morphine. The oral administration of merperidine is not especially satisfactory because the results are variable, due to inactivation in the intestinal tract.

Sedation with merperidine is minimal, making it especially useful in the treatment of individuals in whom depression of respiration is to be feared, especially in the comatose or elderly patient. This also is an advantage in certain clinical conditions such as obstetrics where minimal sedation is desired. This lack of sedative action is a disadvantage in active, young adult patients, especially where sedation is a desirable part of premedication.

Even though patients do not show overt signs of sedation, some depression must exist since the amount of anesthetic required to produce general anesthesia is reduced possibly 25 to 50 per cent, especially if large doses of merperidine are administered. Respiration rarely is depressed. There is little direct depression of the cough reflex although it must not be overlooked that a drying, atropine-like effect of this drug diminishes or makes for a more tenacious sputum which may be difficult to raise.

The lack of marked sedative effect is of distinct advantage in the postoperative care of patients, especially the elderly where a minimum of heavy sedation is desired. This is in keeping with the general trend toward early ambulation and substitution of various muscular exercises, changes of position, induction of coughing and other similar procedures for the heavy medication with morphine as previously used. The specific advantages of merperidine over morphine in postopera-

4. Yonkman, F. F., Pharmacology of Demerol and Its Analogues. Ann. New York Acad. Sci. In press.

tive care are the lack of respiratory depression, its general antispasmodic action and failure to obtund the cough reflex.

In general, this drug has a mild, antispasmodic effect on smooth muscle although this is not a prominent feature of its action on the intestinal tract. Secretions, particularly those of the upper respiratory tract, are inhibited moderately, although the action is not as marked as is obtained with atropine or scopolamine in ordinary clinical doses.

Side actions are very common, usually transient and not particularly serious in nature. As Batterman[5] has shown, they are much more common in ambulatory patients than in bed patients, and more frequent with oral administration of the drug than with parenteral administration. This is also true with morphine.

One of the most common side actions in ambulatory patients is vertigo. Nausea and emesis are not infrequent, and dryness of the mouth is a characteristic sign in many individuals. Occasionally syncope (arterial hypotension) is noted, especially in older individuals, with large doses. This may be noted particularly after the intravenous administration of the drug, which, if employed at all, should be done with the drug in high dilution and at a slow injection rate.

Development of tolerance, if it occurs, is very slow and uncommon. It is in no way comparable to that which occurs with morphine and its derivatives. Although a few cases of addiction to this drug have been reported,[6] most of these have occurred in former morphine addicts; the number of cases of primary addiction to merperidine are few, indeed. It must be recognized that there is a type of acute toxicity of the central nervous system which may be produced if large doses are administered. This toxic psychosis and confusion somewhat resembles that which may occur in heavy barbiturate poisoning and is not related to the problem of addiction.

It may be stated safely that this drug has found a satisfactory place in the armamentarium of the physician, and although it does not serve as a complete substitute for morphine or codeine, it has specific properties that render it useful for certain tasks the physician is required to perform.

Hundreds of derivatives of this substance have been prepared and are at present in various phases of laboratory and clinical study. None of these compounds has appeared yet on the American market, but it safely may be predicted that a derivative will be found which will possess properties superior to those of merperidine. The chemists now have prepared compounds of the merperidine series which are even more potent than morphine by inducing relatively minor changes in the merperidine molecule.

■ *Methadon*

The investigations of one of the Technical Industrial Intelligence Committees[7] sent into Germany at the close of the war by the State Department revealed the fact that the chemists of the I. G. Farbenindustrie, pursuing the lead opened up by their discovery of the analgesic properties of Demerol, had prepared a new series of related substances which

5. Batterman, R. C., The Clinical Effectiveness and Safety of a New Synthetic Analgesic Drug, Demerol. *Arch. Int. Med.* 71:345 (March) 1943.

6. Batterman, R. C., and Himmelsbach, C. K., Demerol—A New Synthetic Analgesic. *J.A.M.A.* 122:222 (May 22) 1943.

7. Kleiderer, E. C., Rice, J. B., and Conquest, V., Report No. 981, Office of the Publication Board, Department of Commerce, Washington, D. C.

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were much more potent than Demerol and compared favorably in analgesic activity to morphine. These compounds were brought to this country for study, and the principal compound is variously known by the Farben serial number 10820, the German code name Amidon. In the United States manufacturers call it Dolophine (Lilly) and Adanon (Winthrop). It has been assigned the nonproprietary name of methadon by the Council on Pharmacy and Chemistry of the American Medical Association. Oddly enough, the German firm, as well as the military authorities, discredited this compound because of the toxic side effects noticed, probably due to the use of too large doses, and it was not used in Germany even though a serious morphine shortage existed.[8]

For the first time in the history of pain relieving substances, a synthetic compound comparable in potency to that of morphine has been prepared. This represents a distinctive and significant advance, in all probability one of the outstanding to come out of wartime researches. This compound now has had rather extensive clinical trial,[9,10] and although investigations are by no means completed, certain facts are established clearly and definitely with regard to its use.

Methadon is 6-dimethylamino-4, 4-diphenyl-3-heptanone. Because of the fact that this compound is optically active, isomers exist which vary considerably in potency. The compound sold commercially, methadon, is a racemic mixture of the *d* and *l* forms. The *d* form is relatively inactive and in some investigators' hands the *l* isomer has been shown to possess activity 25 to 50 times that of the *d* form. The racemic mixture is the only compound commerically available at present. The methadon isomers are in preliminary clinical trial and perhaps the *l* form ultimately will supplant the racemic mixture.

In experimental studies involving the use of the thermal pain threshold, methadon appears to be about twice as active an analgesic as morphine. This ratio has not stood up consistently, however, in clinical use, especially after the oral administration of methadon, and in all likelihood a more exact ratio lies somewhere between one and one and a half times the potency of morphine. As is the case with morphine and merperidine, the analgesic action after oral administration of the drug is not as reliable as when the drug is administerd parenterally.

One of the outstanding characteristics of the new compound is the fact that analgesia is produced with a minimum of sedative or hypnotic effect. Since the amount required to bring about sedation is substantially greater than that required for analgesia, it is possible to bring about pain relief with the minimum of dopiness and sleepiness. In this sense the drug is somewhat analogous to Metopon. This effect is a strong handicap in the use of the drug as a preanesthetic depressant, because in this particular case sedation is desirable, and anesthetists have found methadon unsatisfactory for this purpose. In large doses (above 10 mg.) methadon depresses respiration, somewhat compar-

8. Chen, K. K., Pharmacology of Methadon and Related Compounds. Ann. New York Acad. Sci. In press.

9. Troxil, E. B., Clinical Evaluation of the Analgesic Methadon. *J.A.M.A.* 136:920 (April 3) 1948.

10. Isbell, Harris, Wikler, Abraham, Eddy, N. B., Wilson, J. L., and Moran, C. F., Tolerance and Addiction Liability of 6-dimethylamino-4-4-Diphenyl-Heptanone-3 (Methadon). *J.A.M.A.* 135:888 (Dec. 6) 1947.

able to that of morphine, although as is the case with general sedative effect, analgesia may be obtained without severe respiratory depression.

Generally speaking, the pharmacologic effects of methadon are somewhat similar to those of morphine, including a general stimulant action on the smooth muscle of the gastrointestinal tract resulting in some constipating effect. The effect on smooth muscle in other organs is complicated somewhat and has not been entirely worked out yet. Isolated tissues seem to respond in a different fashion than those studied in their normal place in the body.

Under ordinary circumstances the effects on the circulation are not pronounced; but with large doses arterial hypotension can occur, and a few cases have been reported in which syncope is a serious toxic manifestation of the drug action. Care should be used if the drug is administered by vein. The drug also possesses local anesthetic properties when applied directly to exposed tissues such as the cornea. Thus far this action has not been used clinically.

The drug is absorbed readily from any route of administration and the effect usually lasts two to three hours. The exact fate of the compound in the body is not known. It probably is metabolized in part since only a fraction of that administered can be recovered in the urine.

Toxic side actions are somewhat comparable to those noticed with morphine, the most unpleasant being nausea and vomiting. This occurs in a relatively small fraction of patients and is more common in ambulatory patients. Other side actions include dizziness, euphoria and occasional itching. Batterman and Oshlag have described mental confusion and toxic psychosis occurring in a large percentage of patients over the age of 50 who received the drug at regular intervals in 2.5 to 5 mg. doses for several days. Oddly enough, this particular manifestation of toxicity has not been a prominent feature of its action in the hands of other users.

Thus far, primary addiction to methadon has not been described. Tolerance development is relatively slow in individuals not previously addicted to morphine. One of the interesting characteristics of the drug is that although it does not seem to possess in great degree the qualities necessary to establish a primary addiction, methadon is a highly acceptable substitute for morphine in individuals addicted to the latter drug. Former or "cured" morphine addicts get the same type of euphoria from methadon and in most instances prefer it to morphine. This drug may be substituted completely for morphine with the complete alleviation of all abstinence symptoms.

When methadon is removed subsequently after a period of substitution, only minimal withdrawal symptoms are observed, so that the drug has become the one of choice in the treatment of morphine addiction at the Federal Narcotic Farm at Lexington, Ky. It is too early as yet to determine whether cases of primary addiction will occur, but care should be exercised in using this drug in morphine addicts. Although it will serve as a substitute for morphine, it does not cure the "habit." This distinctive action of methadon with respect to addiction is one of the most interesting and promising aspects of the action of this drug. It is hoped that further studies with chemical derivatives will reveal a substance which is capable

of producing analgesia without any capacity to induce addiction.

Based on experiences to date, it can be stated in summary that (1) methadon, in doses of 2.5 to 20 mg., can serve as a satisfactory analgesic agent in man; (2) analgesia is obtained with a minimum of sedative effect, thus rendering the drug unsatisfactory for premedication but enhancing its value in postoperative care and in the treatment of chronic intractable pain; (3) the side actions of the drug are relatively mild, especially if minimal analgesic doses are administered; and (4) euphoria is not a common feature of action in individuals not previously addicted to morphine. The danger of primary addiction to this compound is small, although it can be substituted for morphine in addicts and is useful in the institutional care of such patients. The most satisfactory use for methadon in surgery is in the treatment of severe postoperative pain where a dose of 10 mg., hypodermically, is usually effective in a high percentage of patients.

■ *Intravenous Procaine*

Thus far only compounds which are new in the temporal sense have been discussed. As medicine advances, new concepts of physiology and biochemistry arise; it is now and always will be true that new uses for old compounds will be found. One of the striking examples of this is the application of procaine as an analgesic agent for systemic use. It always has been considered that every systemic action of this compound was undesirable and they were lumped in a group as toxicity reactions. Although it has been known for many years that large doses of procaine, cocaine and the general class of compounds called local anesthetics were capable of inducing a general state of depression as indicated by the fact that they summate with other known anesthetic agents, it was not until relatively recently that the systemic action of such a compound was put into practical use.

During the war it was learned that the slow intravenous infusion of procaine in doses of 1 Gm. or more dissolved in 500 cc. of normal saline and infused slowly, intravenously, greatly obtunded the pain of certain types of injury in which a fairly widespread destruction of tissue occurred. This was especially true in burns and areas of wide excoriation. One of the theories on this action is that procaine selectively distributes itself in injured or inflammatory tissue. This theory has some support in the fact that in inflammatory tissue blood vessels are injured and hence would be conceivably more permeable to any type of chemical substance.

Although a prolonged discussion of the action of procaine as a general analgesic agent must be omitted, it should be pointed out that subsequent investigations have confirmed the value of this substance, and some surgeons even have had the temerity to use the drug in very large doses for almost complete anesthesia. At the present time the latter use does not seem to be a sound procedure unless one takes the precaution to prevent toxicity by the simultaneous administration of some barbituric acid derivative.

In view of the rapid destruction of procaine in the body, one lethal dose being destroyed by the liver in approximately twenty minutes, it is rather surprising that this drug has such a prolonged effect. Procaine readily is hydrolized to two fairly simple substances, paraamino benzoic acid and diethylaminoethanol, neither one of

them possessing appreciable toxicity. Paraamino benzoic acid has been used in large doses in the treatment of certain infectious diseases, notably Rocky Mountain spotted fever.

Thus far analgesic properties have not been ascribed to this compound. Rovenstine[11] and his group in the Department of Anesthesiology at New York University conceived the idea that possibly the other moiety of the breakdown of procaine might possess analgesic properties. Diethylaminoethanol is a common substance widely used by chemists in the synthesis of a great variety of drugs. Thus far little attention has been paid to it, it being generally assumed that because of its low toxicity it had very little action.

At a recent conference in New York, sponsored by the New York Academy of Sciences, Rovenstine reported studies in his laboratory indicating that large doses (4.5 Gm.) of diethylaminoethanol were tolerated well by vein, producing a high incidence of analgesic response, particularly in the postoperative care of patients. Since this substance lacks the toxicity of the total procaine molecule, this observation is an exceedingly interesting one and obviously deserves further study.

At the present time it is too early to state whether this compound will be of sufficient importance to justify its widespread use, but the discovery points out again the desirability of chemical thinking in the search for new compounds.

In view of the marked advances being made at the present time, it is hoped that within the next few years a compound will be found which possesses those properties so desirable in the truly perfect analgesic: a potent, nonhabit-forming substance with a minimum of unpleasant side actions.—*Department of Pharmacology, University of Michigan Medical School.*

11. Rovenstine, E. A., Use of the New Synthetic Analgesics in Surgery. Ann. New York Acad. Sci. In press.

■ American Board of Oral Surgery

The American Board of Oral Surgery will meet at the Blackstone Hotel in Chicago on April 9, 10 and 11, 1949, at which time examinations for certification will be held.

Requests for application forms or additional information should be addressed to Dr. Leslie M. FitzGerald, Secretary, 718 Roshek Building, Dubuque, Iowa.

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Penicillin therapy in oral surgery

■ *Philip M. Northrop, M.S., D.D.S., Ann Arbor, Mich.*

Penicillin therapy has achieved such universal acceptance that it seems appropriate to summarize the present trends of medical thought concerning its use in the field of oral surgery.

Following Florey's and Chain's[1] confirmation of Fleming's[2] original observations, the literature on penicillin has become so extensive that it is extremely difficult for one to keep well informed. Although a great deal of excellent work is constantly being reported, many publications are based on studies which are not scientifically conducted and are in truth personal impressions or interpretations of the author. Although the reader should maintain an open mind at all times, without prejudice, he should not accept conclusions unless they withstand critical appraisement.

With this in mind, it is the purpose of this article to present briefly information which has been well established and accepted, although certain opinions will be expressed in the practical application of these data as they are related to the subject. These opinions will require logical evaluation on the part of the reader.

The subject will be discussed as follows:

1. Basic Information—Certain fundamental principles must be understood concerning penicillin in order to understand its practical clinical use.

2. The clinical application of penicillin therapy.

■ *Basic Information*

According to Kolmer,[3] one of America's foremost students of biologic therapy,

> Chemotherapeutic compounds are substances capable of specifically or selectively injuring or destroying the living agents of disease in the body (in-vivo) usually without serious toxic effects on the host. Of all of the chemotherapeutic agents known at the present time, penicillin comes nearest to this ideal.
>
> When compounds are capable of selectively killing micro-organisms, this is spoken of as bactericidal activity. In other instances compounds cripple the proliferating activities of micro-organisms, or otherwise interfere with important metabolic functions so that their final destruction or removal from the body fluids and tissues by phagocytosis or other immunological mechanisms is possible. In the case of bacteria, this is designated as bacteriostasis.
>
> It appears that the therapeutic properties of penicillin, the sulfonamide compounds, streptomycin and other antibiotics, are largely, if not entirely, dependent upon bacteriostatic activity. Chemotherapy appears to depend largely upon the use of compounds capable of selectively interfering with certain metabolic activities of micro-organisms which reduce their viability and resistance through the destruction of their enzymes, products and structural components.

Read at the thirtieth annual meeting of the American Society of Oral Surgeons, Chicago, September 9, 1948.

Associate professor of oral surgery, School of Dentistry, University of Michigan, Ann Arbor.

1. Chain, E., and others, Penicillin as a Chemotherapeutic Agent. *Lancet* 2:226 (Aug. 24) 1940.

2. Fleming, A., On Specific Antibacterial Properties of Penicillin and Potassium Tellurite: Incorporating Method of Demonstrating Some Bacterial Antagonisms. *J. Path. & Bact.* 35:831 (Nov.) 1932.

3. Kolmer, J. A., *Penicillin Therapy, Including Streptomycin, Tyrothricin and Other Antibiotic Therapy*, second ed. New York: Appleton-Century, 1947, pp. 1-2.

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GENERAL RULES FOR TREATMENT—The gram-positive organisms and certain gram-negative cocci are mainly sensitive to penicillin, whereas the majority of gram-negative bacilli are insensitive.

Gram-positive (usually sensitive)

Staphylococcus aureus
Staphylococcus albus
Streptococcus haemolyticus
Streptococcus viridans
Some anaerobic streptococci
Pneumococci
Micrococci
Gonococci
Meningococci
Bacillus diphtheriae
Spirochetes

Insensitive Organisms

Streptococcus faecalis
Typhoid bacilli
Influenza bacilli
Tubercle bacilli
Most viruses
Yeasts
Molds
Monilia
Some strains of Staphylococcus

Rule I—It should be used when there is an infection by a penicillin sensitive microbe. This means it should not be used for colds, canker sores and so forth, unless for the purpose of preventing or controlling a secondary infection.

Rule II—It is desirable that the sensitivity of the organism to penicillin be determined whenever possible. Practically all hospitals are now equipped so that the degree of sensitivity can be determined, with most organisms, in a twenty-four hour period. It is obvious that a very sensitive microbe will be destroyed with smaller doses of penicillin than one which, although sensitive, is much less susceptible.

In acute conditions, penicillin therapy should be instituted immediately. When the bacteriologic report has been received, the continuance of treatment or dosage can be reconsidered further. Delay in treatment may jeopardize the patient's life.

Fortunately, many of the organisms in the mouth or in adjacent structures are penicillin sensitive.

Rule III—The dose should be such that in the infected area the concentration of the penicillin should be sufficient to destroy the bacteria.

Rule IV—Treatment should be continued until the infection is overcome.

COMBINATION OF PENICILLIN WITH SULFONAMIDES—It appears that penicillin and the sulfonamides are not incompatible; in fact, it is suggested that they have a synergistic action when used together. Kolmer[4] states that "insofar as effects *in vitro* are concerned, it would appear that the sulfonamide compounds may or may not affect the antibacterial effects of penicillin. Nevertheless, it has been observed that the simultaneous administration of penicillin by intramuscular or intravenous injection and sulfonamide compounds by ingestion appeared to yield better therapeutic results in the treatment of some cases of meningitis, septicemia, and other severe infections, than could be expected from either alone." In addition, many sulfonamide resistant organisms have been shown to be susceptible to penicillin.[5-7]

4. Kolmer, J. A.,[3] p. 63.

5. Frisch, A. W., and others, Susceptibility of Sulfonamide-Resistant Gonococci to Penicillin. *Am. J. Syph., Gonor. & Ven. Dis.* **28**:627 (Sept.) 1944.

6. Bennett, T. I., and Parkes, T., Penicillin in Sulphonamide-Resistant Pneumonias with Special Reference to Staphylococcal Infection and Empyema. *Lancet* **1**:305 (March 4) 1944.

7. Spink, W. W., and others, Clinical Significance of Staphylococci with Natural or Acquired Resistance to Sulfonamides and to Penicillin. *J.A.M.A.* **128**:555 (June 23) 1945.

From this information it can be understood that when treating a fulminating severe infection, a combination of penicillin and a sulfonamide should be administered for the most effective result.

TYPES—It is now known that penicillin does not occur as a single substance in culture of Penicillium notatum. Several types or kinds of substance have been identified and named as penicillin F, G, X and K in the United States, and as penicillin I, II, III and IV, respectively, in England in accordance with the historical order of their discovery. Penicillin F, G and X have been isolated in crystalline form. The commercial penicillin is for the most part of the G type.

Penicillin occurs as a free acid in culture filtrates of Penicillium notatum and readily forms various salts, among which those of sodium, calcium and potassium are best known.

PROPERTIES—1. Penicillin is bacteriostatic to certain organisms, especially the gram-positive and gram-negative cocci.

2. Penicillin is bactericidal to certain organisms in their growing phase.

3. It is ineffective against certain bacteria, mainly many or the majority of gram-negative bacilli.

4. Penicillin maintains its activity in the presence of blood, serum, pus and large numbers of bacteria. It has no harmful effect on the leukocytes and is relatively nontoxic either locally or systemically.

5. It is rapidly excreted in the urine, and it is necessary to maintain the concentration of penicillin during treatment.

6. Penicillin is readily inactivated by heat, its thermostability being maximal when the substance is dry and minimal when water or moisture is present. The sodium salt is very hydroscopic and more liable to decompose during storage than the calcium salt. The calcium salt is more suitable for dry preparations of penicillin, such as tablets and for insufflation powders.

7. Aqueous solutions of penicillin, once the solution is made up, rapidly lose their potency. For this reason, one should make up solutions so that they will be used within two days. It is, therefore, desirable to purchase vials containing only 100,000 or 200,000 units.

8. Oily suspensions of the dry substance should be relatively stable.

During the early development of penicillin, attention was focused almost entirely on the salts which were water soluble. Attempts were made to prolong the action of the drug either by slowing the absorption of the drug or delaying the rate of its elimination through the renal tubules.

Reasonable success was obtained in prolonging therapeutic effective concentrations following single injections of the drug by the use of penicillin suspended in peanut oil and beeswax. This preparation was further improved by the use of penicillin crystals of large particle size. This was shown by Dowling, Romansky and their group[8] to retard further the rate at which penicillin is dissipated and thus maintain a higher prolonged action of the drug.

Although this material prolonged the blood concentration of penicillin at a therapeutic level for eighteen to twenty-

8. Dowling, H. F., and others, (Prolongation of Penicillin at Injection Site.) Presented at the meeting of the syphilis study section, Washington, D. C., Sept. 24, 1947.

four hours, local reactions as manifested by pain, sterile abscesses and allergic phenomena occurred frequently enough so that its employment was not entirely satisfactory.

Recently a procaine and penicillin salt suspended in oil has been submitted and will be discussed in more detail further on in the paper.

An aqueous suspension of penicillin in chemical combination with a procaine base (Crysticillin) is now available. Insufficient data has been accumulated to evaluate accurately this method of effectively prolonging penicillin blood levels.

The rapid progress in methods and improvements in penicillin emphasizes the statement previously made that it is difficult to keep accurately well informed on the ever changing problem of penicillin therapy.

9. Acids or alkalis decompose penicillin. The optimum pH for stability is 6 to 6.5, while the practical range is 5.5 to 7.5.

10. Certain heavy ions such as copper, lead, mercury and silver tend likewise to decompose penicillin; also oxidizing agents have a similar reaction. Therefore, oxidizing mouth washes such as hydrogen peroxide should not be used if penicillin lozenges are being used.

11. There is some evidence that certain sensitive pathogenic bacteria may develop resistance or become resistant to penicillin, as shown by many investigators.[9-12] It is thought that highly susceptible organisms are rapidly destroyed. However, others having a greater resistance may escape destruction and actually develop an increased resistance. This brings up the importance of the relation of dosage, which should be adequate to eliminate completely the resistant variants as well as the highly susceptible bacteria as soon as possible. Especially is this true in early infections when organisms are in a developing phase.

12. Penicillin is freely soluble in water, isotonic salt solutions, exudates and body fluids to the extent of 100,000 units per cubic centimeter. In the preparation of aqueous solutions, it is desirable to dissolve the penicillin in small quantities of solution such as 30,000 to 100,000 in 1 cc. of physiologic pyrogen-free saline solution. The decrease of the quantity of the solution, especially when administered by the intramuscular route, will provide less muscular injury during injection.

DIFFUSION IN THE BLOOD STREAM—At least 90 per cent of penicillin in the venous blood occurs free in the serum or in the plasma, and less than 10 per cent in the blood cells.

TOXIC REACTIONS TO PENICILLIN—Penicillin produces extremely low toxic reactions in man; in fact, of all the chemotherapeutic drugs except streptomycin, there is no compound or group of compounds that exhibit such low toxicity with such high therapeutic activity.

Herxheimer Reactions—These reactions, or therapeutic shock, have been reported following the administration of

9. Schmidt, L. H., and Sesler, C. L. Development of Resistance to Penicillin by Pneumococci. *Proc. Soc. Exper. Biol. & Med.* **52**:353 (April) 1943.

10. Rammelkamp, C. H., and Maxon, Thelma, Resistance of Staphylococcus Aureus to the Action of Penicillin. *Proc. Soc. Exper. Biol. & Med.* **51**:386 (Dec.) 1942.

11. Lyons, C., Penicillin Therapy of Surgical Infections in the U. S. Army. *J.A.M.A.* **123**:1007 (Dec. 18) 1943.

12. Dunham, W. B., and others, Action of Penicillin and Other Antibiotics on Treponema Pallidum. *Proc. Soc. Exper. Biol. & Med.* **55**:158 (March) 1944.

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penicillin in the treatment of syphilis.[13, 14] They produce exacerbations of the lesions and symptoms after the use of the drug; the reactions vary in degree of severity and although delayed in occurrence, as a rule they take place within the first day or two. These reactions usually can be prevented by administering reduced doses of penicillin during the first twenty-four or forty-eight hours of treatment.

Uterine Reactions—Penicillin may stimulate uterine contractions and bleeding in pregnant women or initiate menstruation.[15] However, these reactions may be caused by an impurity rather than the penicillin itself.

Effect on Blood Coagulation—Moldavsky and his group[16] have shown that the oral and intramuscular administration of penicillin in doses of 100,000 units increases the coagulation time of the blood.

Local Reactions—Temporary tenderness and some pain at the site of injection usually is experienced when an aqueous solution of penicillin is given. The amount of fluid is an important factor. For this reason, it is advisable to administer the agent in 1 cc. of solution, whether it be 20,000 units or 100,000 units. Procaine may be incorporated in the solution, if desired. Lundy and Osterberg[17] have shown that penicillin is not destroyed when dissolved in 0.5 per cent solutions of procaine. The newer penicillin procaine solutions, aqueous or in oil, can be administered with practically no local reaction other than the initial prick of the needle.

PHLEBITIS AND THROMBOPHLEBITIS—These are infrequent and only likely to occur at the site of intravenous injection of penicillin, when the continuous drip method is followed. The use of dilute solutions and daily change of the position of the needle will prevent this complication.

GENERAL REACTIONS—Other reactions such as chills, fever, headache, unpleasant taste, flushing of the face, muscular and abdominal pains may follow intravenous and intramuscular injections of penicillin. These reactions are caused by impurities in the compound, especially pyrogens. Improvement in methods of production of the drug has practically eliminated these unpleasant reactions.

ALLERGY—About 5 per cent of human beings possess a natural allergy to penicillin itself, or impurities and other compounds incorporated in the solutions such as procaine, oil and so forth, or acquire allergic sensitization as a result of treatment.

Allergic phenomena produce reactions such as urticaria, contact dermatitis, mild skin rashes, generalized pruritus, herpes simplex, eosinophilia and so forth.

ANTI-HISTAMINE DRUGS IN PENICILLIN THERAPY—Individuals who have had allergic responses to penicillin in previous treatment can safely be re-penicillinized by the administration of anti-histamine preparations. The drugs most commonly used are benadryl, pyribenzamine and

13. Mahoney, J. F., and others, Penicillin Treatment of Early Syphilis: II. *J.A.M.A.* 126:63 (Sept. 9) 1944.

14. Stokes, J. H., and others, Action of Penicillin in Late Syphilis Including Neurosyphilis, Benign Late Syphilis and Late Congenital Syphilis. *J.A.M.A.* 126:73 (Sept. 9) 1944.

15. Leavitt, H. M., Clinical Action of Penicillin on the Uterus. *J. Ven. Dis. Inform.* 26:150 (July) 1945.

16. Moldavsky, L. F., and others, Studies in Mechanisms of Penicillin Action. I. Penicillin Effects on Blood Coagulation. *Science* 102:38 (July 13) 1945.

17. Lundy, J. S., and Osterberg, A. E., Use of Antibacterial Agent Mixed with Local Anesthetic. *Proc. Staff Meet., Mayo Clin.* 20:40 (Feb. 7) 1945.

neoantergen in doses of 50 to 100 mg. taken every three hours for the adult.

EFFECTIVE PENICILLIN LEVEL—There is no complete unanimity of opinion concerning the optimal penicillin blood level. The dosage should be such as to maintain at all times adequate penicillin in the blood to inhibit the growth of the infecting bacteria. This amount varies from 0.01 to 2.0 units per cubic centimeter. Generally, it is agreed that for the usual infection a blood level of 0.15 units per cubic centimeter is adequate. Blood level determinations, although desirable, are not always necessary, since the clinical observations are helpful criteria. The present trend of thought with regard to dosage, frequency and method depends on the individual case with an emphasis on high medication. This is especially true in the management of severe infections.

■ *Methods of Administration*

INTRAVENOUS INJECTIONS—High blood levels are immediately reached by this method. Excretion is so rapid that blood concentrations may be reduced 50 to 75 per cent at the end of fifteen minutes and 90 per cent at the end of thirty minutes, the remaining 10 per cent disappearing in three to four hours.

This method is employed where one is desirous of obtaining an immediate high blood level, such as in: (1) severe infections, while the penicillin given by other routes is taking effect; or (2) in office practice, when delay in waiting for some other method to become effective is undesirable.

CONTINUOUS INTRAVENOUS AND INTRAMUSCULAR INJECTIONS—This method is used in acute, severe infections, especially during the initial treatment. High, constant blood levels are attained by such a procedure. This means of administering penicillin requires constant supervision and the use of large fluid volumes. Thrombophlebitis can occur if care is not great or treatment is prolonged.

INTERMITTENT INTRAMUSCULAR INJECTIONS—Aqueous or glucose solutions of penicillin given by this method produce fairly rapid absorption. The initial blood level is not as high as the level following intravenous injection. However, the blood concentration is of longer duration (thirty to forty-five minutes) because of slower absorption and excretion. The following table shows in part the findings of Loewe[18] and his associates.

18. Loewe, L., and others, Superiority of Continuous Intravenous Drip for Maintenance of Effectual Serum Levels of Penicillin. *J. Lab. & Clin. Med.* 30:730 (Sept.) 1945.

TABLE 1

Serum levels after intermittent intramuscular injections

DOSE-UNITS (in adult)	UNITS PER CUBIC CENTIMETER OF SERUM			
	½ hour	1 hour	2 hours	3 hours
30,000	0.2-0.6	0.2-0.4	0.2-0.3	0.1-0.2
40,000	0.4-0.6	0.3-0.4	0.2-0.3	0.1-0.2
50,000	0.5-1.0	0.4-0.8	0.3-0.4	0.2-0.3
100,000	1.0-1.8	0.8-1.2	0.2-0.8	0.1-0.6

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From this table it appears that for the average case, if one accepts 0.15 units of penicillin per cubic centimeter of serum as a satisfactory concentration, 30,000 units given every three hours should be an adequate dosage. The severity, type of infection, general health of the patient and other factors would greatly influence the necessity for an increase in medication.

If penicillin is to be given as a prophylactic measure, either in a single dose or with some other preparation such as penicillin procaine, it should be administered twenty to thirty minutes prior to surgery. This delay permits the blood level to reach a maximal point at the time of operation.

ORAL ADMINISTRATION—Adequate blood levels can be obtained by the use of tablets or capsules of dried penicillin, along with various buffers, suspensions or other means by which there is protection against inactivation by the gastric juices. This method is the least reliable of all because of individual variations in the absorption and excretion. It is more expensive because of the great waste, since it appears that a dose five times larger than an intramuscular injection is necessary to obtain comparable serum levels.[19] When administered, it should be on a fasting stomach no less than a half hour before or two hours after meals. With the more recent penicillin procaine preparations available, its use is questionable except perhaps under certain circumstances when daily injections cannot be made. Certainly, if prescribed, the oral administration of penicillin should be used on the less serious infections.

PENICILLIN IN PEANUT OIL AND BEESWAX—This preparation, although a valuable contribution in the evolutionary progress of penicillin therapy, now has been replaced by the more effective procaine penicillin products.

PROCAINE PENICILLIN G IN OIL—Preliminary reports in December, 1947, by Herrell[20] and in March, 1948, by Boger[21] and their groups, concerning procaine penicillin suspended in oil, were very encouraging. The first preparation of this type was called Duracillin. Several pharmaceutical firms now have similar preparations.

This product consists of procaine and penicillin G combined in equimolecular quantities to form a crystalline salt relatively insoluble in water. This salt is suspended in sesame oil so that each cubic centimeter of material contains 300,000 units of penicillin and 125 mg. of procaine.

The above mentioned reports won universal acceptance, and clinical observation has established this material as an extremely satisfactory means of injecting penicillin and obtaining an adequate blood level which is maintained usually eighteen to twenty-four hours or longer. The previously used beeswax and peanut oil, both of which produced not only local reactions but frequently allergic responses, are eliminated. This product can be easily administered with little discomfort and produces blood levels in comparison with

19. Kolmer, J. A.,[2] p. 87.

20. Herrell, W. E., and others, Procaine Penicillin G (Duracillin): A New Salt of Penicillin Which Prolongs the Action of Penicillin. *Proc. Staff Meet., Mayo Clin.* 22:567 (Dec. 10) 1947.

21. Boger, W. P., and others, Procaine Penicillin G in Oil. I. Plasma Concentrations: Preliminary Observations on Its Use in Pneumonia. *Am. J. Med.* 215:250 (March) 1948.

penicillin in beeswax and oil that are 10 per cent higher at twelve hours and ten times greater at the twenty-four hour period following injection.[22]

This material is purchased in 1 to 10 cc. vials which do not require refrigeration. Great care in the cleansing of the needles and syringes is necessary. Each cubic centimeter contains 300,000 units of penicillin at a cost of 90 cents to 1 dollar. An injection of 300,000 units every twenty-four hours usually provides adequate antibacterial activity. The administration of 300,000 units every twelve hours or 600,000 units daily is even more reliable if certainty of a high blood level of penicillin and its maintenance is necessary. At present, in many hospitals this method is replacing the intermittent intramuscular injections of penicillin in aqueous solutions, since it appears that satisfactory blood concentrations are obtained without subjecting the patient to injections every three hours.

Its use in an office practice for ambulatory patients readily can be appreciated, especially since it can be easily given repeatedly in the deltoid muscle. An aseptic technic must be observed. It is imperative that the suspension should not be deposited in a blood vessel. Although injection into a vein is rare, it is certainly possible. One should always draw back on the plunger of the syringe to make certain that the needle point is not within a vessel before injecting the fluid.

An even better method is the two syringe technic. One syringe is filled with the quantity of the procaine penicillin needed and the needle is removed. With an entirely different needle and empty syringe, the introduction of the needle is made into the muscle. The plunger is slightly withdrawn, thus readily showing if the needle is within a vessel, for blood will be seen in the empty syringe during aspiration. If a vessel is penetrated, the procedure is repeated until aspiration shows no return of blood. The needle is kept in place and the syringe is removed and replaced with the syringe containing the procaine penicillin and injected. Such a method guarantees that a blood vessel has not been entered and saves the material, for the usual technic requires aspirating with the plunger and syringe, with the penicillin ready for injection. If blood is aspirated into the syringe, the procedure must be repeated and the material discarded.

TOPICAL METHODS—Solutions of 1,000 units of penicillin per cubic centimeter or even higher concentration have appeared to be effective in prevention of infections, although it should be remembered that penicillin requires prolonged contact with the infected tissues in order to be of any great value.[23]

POWDERS—Penicillin powders of the calcium salt (5,000 units to 1 Gm. of equal parts sulfanilamide and sulfathiazole), if frosted lightly in a wound or cavity, especially after the removal of an impacted tooth, have seemed to be effective in preventing the breakdown of the blood clot. Previous to the use of this type of powder, the majority of cases where impacted teeth were removed required some type of postoperative sedative dressing. A series of 100 cases of all types of impactions where penicillin sulfonamide powder was used required postop-

22. Bierwalters, W., Personal communication. June 1948.
23. Kolmer, J. A.,[3] p. 130.

erative dressings in seven cases, or 7 per cent. Since that time, over two years ago, the light frosting of the wound with this type of powder has become a routine procedure.

In considering the amount of powder that should be used on an exposed surface in oral surgery, let us review the amount of penicillin in the blood stream thought to be satisfactory for antibacterial activity. It was stated that a blood or serum level of 0.15 units of penicillin per cubic centimeter is generally considered adequate. Kolmer[24] states that approximately 8 units per square centimeter are sufficient when powdered penicillin is lightly frosted on a wound exposed or one to be closed. It can be appreciated that even light insufflation of a wound or socket would create a concentration per square centimeter of penicillin many times greater than that which Kolmer advocates. Although the effects of extremely high concentrations of penicillin are not known from the information given previously, there is no need to use excessive quantities of the powder in order to obtain the desired results. The sulfonamides with penicillin act as satisfactory vehicles as well as having certain definite antibacterial properties themselves.

Sulfanilamide and sulfathiazole have been shown by Ostrander and Kerr[25] to be justifiable, if used sparingly, as a prophylactic measure in regions where existing infection or trauma might predispose to postoperative infections.

In addition to the use of powdered penicillin and sulfonamides following the removal of impacted teeth, we have insufflated any site in the manner recommended, not as a routine method, but when excessive trauma was necessary and where infection or complications were more apt to occur.

TROCHES—Penicillin incorporated in slowly dissolving troches has been available for some time. At first these troches were dispensed in amounts as small as 500 to 1,000 units per tablet. At present, the lowest amount of penicillin per tablet is 5,000 units, although preparations of 20,000 units per tablet or more can be purchased. This method produces a high concentration in the mouth; in fact, when treating infections in the oral cavity affecting the mucous membrane surfaces, more effective results occur by the use of troches if the bacteria are susceptible than by the parenteral route.[26] The high salivary level of penicillin reaches crevices and pockets exceedingly well. Where infections of the mucosa extend into the throat and pharynx, this method of treatment is not so satisfactory.

In the School of Dentistry at the University of Michigan, troches are used in indicated infections, using tablets with a concentration of 20,000 units of penicillin prepared in a paraffin base. These tablets are cut into four equal parts, one being chewed every three or four hours. The penicillin, plus the slow masticatory action, seems to give more effective results than those types of troches without a paraffin base that are placed in the mouth at frequent intervals where they slowly dissolve.

Troches should not be used indiscriminately for trivial reasons. Many investigators have reported a painful stomati-

24. Kolmer, J. A.,[3] p. 132.
25. Ostrander, F. D., and Kerr, D. A., Recent Trends in Use of Sulfonamides. *J.A.D.A.* 35:461 (Oct. 1) 1947.
26. Ostrander, F. D., Personal communication. April 1948.

tis following their use.[27–30] The tissue of the lip, tongue and cheek become red, shiny and extremely sensitive, especially to certain foods, tobacco, spices, spirits and so forth. These reactions possibly may be caused by some ingredient in the troche other than the penicillin on an allergic basis. It is also possible that the penicillin changes the oral flora and permits injury of the mucous membrane by insensitive bacteria. The symptoms and signs disappear readily when the troches are discontinued.

■ *Clinical Application of Penicillin Therapy*

The great majority of dental and oral infections are caused by organisms which fortunately are sensitive to penicillin. It, therefore, seems reasonable to expect considerable benefit from the use of this remarkable drug.

The use of penicillin by various methods, alone or in combination with sulfonamides, certainly has been accepted as the treatment of choice along with other supportive care in the management of serious infections of the oral cavity. Early adequate amounts of penicillin should be administered at least until clinical observation demonstrates its value, or until the sensitivity of the organism is determined. The principles of penicillin therapy should be kept in mind at all times.

It should be emphasized at this time that penicillin therapy alone is no substitute for sound surgery. Whenever an accumulation or localization of pus occurs, drainage should be established.

In the less serious types of infections such as early abscesses, moderate or severe paracoronal inflammatory processes, or where potentially a more serious complication may develop, it seems reasonable that this type of therapy should be instituted.

Penicillin therapy for the office patient can safely be given by the dentist, especially with currently available prolonged action procaine penicillin preparations. An aseptic technic in its parenteral use must be observed. Patients welcome its added safety and are willing to pay for this service. There have been cases of indiscriminate use of penicillin on the oral surgery patient as well as the charging of unreasonable fees for a product which is now sold at a fair price.

PROPHYLACTIC VALUE—The prophylactic value of penicillin is worthy of serious attention. Considering the information previously given, it seems a reasonable attitude that its use as a prophylactic measure is often indicated. I do not wish to infer that it should be used routinely on every patient, but that its use in selected cases is highly desirable. I am convinced that prophylactic therapy for an individual in poor physical health, where infection or poor oral hygiene exists, gives increased safety to the patient. I have felt more at ease in performing an incision and drainage of an acute abscess, or when removing an impacted third molar with the recent history of paracoronitis, to have the patient adequately penicillinized at the time of surgery and for a variable

27. Farrington, Joseph, and others, Stomatitis After Administration of Penicillin. *J. Oral Surg.* 5:149 (April) 1947.

28. Wright, R. B., and Rule, W., Penicillin Lozenges in the Treatment of Oral Lesions. *J. Calif. D. A.* 21:177 (Nov., Dec.) 1945.

29. Goldman, L., Cheilitis from Local Use of Penicillin Solutions in the Mouth. *Arch. Dermat. & Syph.* 53:133 (Feb.) 1946.

30. Cook, T. J., Stomatitis Following the Use of Penicillin Troches. *Oral Surg., Oral Med. & Oral Path.* 1:265 (March) 1948.

postoperative period, depending on the individual case. Its use in this way, during the past three and a half years, has convinced me of its value by the clinical results obtained.

Frankly, although observant of fundamental surgical principles, I have been more radical in the removal of teeth or in establishing drainage when penicillin has been administered. Often over-conservatism permits an infection to progress to a point where a serious condition develops, and at the same time the patient suffers great discomfort.

The following routine is employed when penicillin is given as a prophylactic measure, with the exception of patients having endocarditis. The dosage may be increased in amount and frequency, and the duration of treatment varies markedly depending on the individual case.

1. 30,000 to 50,000 units of aqueous solution in 1 cc. of pyrogen-free physiologic saline solution may be given intravenously if an immediate blood level is desired and delay in operation would cause interruption of the office routine. If this method is followed, the same amount of penicillin is given intramuscularly. The intramuscular injection requires twenty to thirty minutes for the serum level to reach an optimal concentration.

2. The intravenous injection is excreted rapidly; in fact, 90 per cent is lost at the end of a half hour. If the two types of injections are made at the same time, the intramuscular injection builds up the blood concentration so that it carries on after the first intravenous injection loses its effectiveness. If delay before operation can be permitted, the intravenous injection is omitted. For prolongation of the penicillin level, 300,000 units of procaine penicillin or Duracillin in oil is given at the same time as the intravenous or intramuscular injection. This preparation generally requires one hour before an adequate penicillin concentration is reached.

3. If penicillin therapy is to be continued more than one day, procaine penicillin is readministered preferably in eighteen hours and continued in the same manner as long as needed. Should one desire complete assurance that a high penicillin blood level be attained and maintained the full twenty-four hours, or until the repeated dose is given, 600,000 units of procaine penicillin will serve this purpose as implied by the studies of Boger and co-workers.[21]

The prophylactic use of penicillin as a powder with sulfanilamide and sulfathiazole should be stressed. In indicated cases, it is felt to be an efficacious method in combating sensitive bacteria, and it decreases postoperative oral surgery complications such as infections, the breaking down of the blood clot resulting in dry sockets, Vincent's infection, antral involvement and so forth, if the principles of administration previously discussed are followed.

PATIENTS WITH ENDOCARDITIS—Patients with preexisting valvular heart disease, especially as a result of rheumatic fever and congenital cardiac involvement, are always candidates for subacute bacterial endocarditis, especially if any type of surgery is to be performed.

Subacute bacterial endocarditis is a serious disease resulting from the localization of bacteria on previously damaged heart valves. The source of the bacteria is thought to be caused by local injury or trauma which results in their liberation

into the blood stream. The release of the organism from the site in the blood stream is spoken of as bacteremia and is transient, the organisms remaining only three to five minutes, after which they disappear. In 281 blood samples taken ten minutes after surgical procedures, in various studies we have carried out,[31,32] only one positive culture was found. The organism was Staphylococcus aureus. In this case, the sample taken immediately after surgery was negative, so its significance was doubtful.

Many investigators have shown that transient bacteremias frequently follow surgical or manipulative procedures, not only after dental operations,[33-35] but following tonsillectomy[36] and urologic operations,[37] as well as operative procedures elsewhere in the body.

Since this discussion deals primarily with the oral cavity, it is important to stress the fact that transient bacteremias have been shown to occur immediately after one or two dental extractions, in about 17 per cent of the cases, when performed under local anesthesia.[32,35,38] Recently Glaser and others[39] have reported the effect of preoperative penicillin on bacteremias following the extraction of teeth. In their control series of only 40 cases where no penicillin was administered, they found an incidence of bacteremia in 67 per cent of the cases. The findings are about the same as shown by Okell and Elliott,[33] who were the first investigators to show that this phenomenon followed the extraction of teeth; however, their study was made using a general anesthetic.

The great difference between the incidence of bacteremia under local anesthesia of 17 per cent, prior to the report of Glaser and his group, and under general anesthesia of 64 per cent as shown by Okell and Elliott, was attributed to the vasoconstrictor action of the epinephrine incorporated in the local anesthetic solutions. Since Okell's and Elliott's work has not been confirmed, further studies would be of interest in order to determine if the type of anesthetic, either general or local, influenced the frequency of bacteremia.

The great difference in incidence of bacteremia as reported by Glaser and his group (67 per cent) and our original control series (16.1 per cent) is difficult to evaluate as comparative conditions under which both investigations were carried out are not shown. Although differences in findings exist, the important fact remains that bacteria frequently enter the blood stream after oral surgical procedures.

SIGNIFICANCE OF TRANSIENT BACTEREMIA—Bacteremias in the normal individual probably are of little significance, as the blood stream quickly destroys the newly introduced organisms. In the individual with valvular heart disease, if circumstances are ideal, these bacteria may localize on the heart valves and produce

31. Northrop, P. M., and Crowley, M. C., Prophylactic Use of Sulfathiazole in Transient Bacteremia Following the Extraction of Teeth. *J. Oral Surg.* 1:19 (Jan.) 1943.

32. Northrop, P. M., and Crowley, M. C., Further Studies on the Effects of the Prophylactic Use of Sulfathiazole and Sulfamerazine on Bacteremia Following the Extraction of Teeth. *J. Oral Surg.* 2:134 (April) 1944.

33. Okell, C. C., and Elliott, S. D., Bacteremia and Oral Sepsis. *Lancet* 2:869 (Oct. 19) 1935.

34. Elliott, S. D., Bacteremia and Oral Sepsis. *Proc. Roy. Soc. Med.* 32:747 (May) 1939.

35. Burket, L. W., and Burn, C. G., Bacteremia Following Dental Extractions. *J. D. Res.* 16:521 (Dec.) 1937.

36. Elliott, S. D., Bacteremia Following Tonsillectomy. *Lancet* 2:589 (Sept. 9) 1939.

37. Scott, W. W., Blood Stream Infections in Urology. *J. Urol.* 21:527 (May) 1929.

38. Hopkins, J. A., Streptococcus Viridans: Bacteremia Following Extraction of Teeth. *J.A.D.A.* 26:2002 (Dec.) 1939.

39. Glaser, R. J., and others, Effect of Penicillin on the Bacteremia Following Dental Extraction. *Am. J. Med.* 4:55 (Jan.) 1948.

subacute bacterial endocarditis. Of further significance is the fact that subacute bacterial endocarditis usually is produced by the Streptococcus viridans organisms. Streptococcus viridans is a common inhabitant of the gastrointestinal tract and also the organism most frequently found in the blood stream during a transient bacteremia following dental extractions. With this information in mind, it becomes apparent that any form of injury in the mouth of a patient with rheumatic and congenital endocarditis may, by means of bacteremia, produce a subacute bacterial endocarditis.

This complication prior to the advent of penicillin was practically always fatal, but since the use of this antibiotic, if adequately administered with tremendous daily doses for a sufficient length of time, cures can be obtained in the majority of cases.[40]

Subacute bacterial endocarditis may develop in patients with valvular scarring (endocarditis) other than following rheumatic fever or congenital cardiac disease. Only recently a patient treated at the University hospital developed subacute bacterial endocarditis. He had endocarditis previously with no history of rheumatic fever or congenital heart abnormality. The septicemia itself was cured with penicillin treatment, as shown at autopsy, but the patient died suddenly with coronary thrombosis.

Although the patient with endocarditis rarely develops subacute bacterial endocarditis, considering the opportunities for its occurrence, it is now generally accepted by medical authorities that surgery of any type should be performed only when the individual is adequately penicillinized.

The prophylactic use of penicillin is advocated as the chemotherapeutic agent of choice since most of the bacteria producing bacterial endocarditis, especially Str. viridans, are sensitive to this drug. In addition, evidence accumulated during the past few years shows that penicillin therapy is curative in a high percentage of cases having subacute bacterial endocarditis.[40] This knowledge is of great significance; for the first time in medical history recovery can be expected if early diagnosis is made and adequate medication instituted. Further, it seems reasonable to assume that if penicillin is curative, once the disease becomes established at least in a high percentage of cases, then the same drug, if adequately administered, should be of great value as a preventive measure. Fundamentally the need of penicillin prophylaxis, in dealing with the patient with endocarditis where a bacteremia may occur from any source, is derived from these deductions. Although the exact preventive effect of penicillin therapy in this type of case is not yet known, it seems reasonable that its use is highly desirable in affording added protection by decreasing the possibility of development of subacute bacterial endocarditis.

PRINCIPLES OF PENICILLINIZATION—With the establishment of the need for prophylactic therapy in the management of the patient with an endocarditis, where bacteremia may occur, there seems to be considerable uncertainty as to what constitutes adequate penicillin treatment. There appears to be confusion as to dosage, when the agent should be admin-

40. Tumulty, P. A., and Harvey, A. M., Experiences in the Management of Sub-Acute Bacterial Endocarditis Treated with Penicillin. *Am. J. Med.* 4:37 (Jan.) 1948.

istered if surgery is to be performed and the length of time treatment should be continued.

Because bacteremias were known to be transient in the blood stream, we thought at first that a high penicillin level was needed only at the time of operation. A single intravenous injection, or an intramuscular injection of aqueous penicillin of 50,000 units one-half hour prior to surgery, could produce an immediately adequate penicillin level.

We were also aware that our medical department at the University hospital, as well as such investigators as Glaser and others,[39] advocated the pre- and postoperative use of the drug usually one day prior to surgery and two or more days following. However, the necessity for preoperative or postoperative medication was questioned. In order to understand the problem more clearly and to establish a satisfactory procedure of penicillin therapy, an extensive study was made. In addition, several well-known authorities on the clinical use of antibiotics were consulted through correspondence. The personal comments from these outstanding medical men were most interesting. The common consensus of opinion strongly favored the use of adequate penicillin therapy twenty-four hours preoperatively and its administration for two or more days postoperatively.

It was felt that, because penicillin may prevent subacute bacterial endocarditis, the optimal effect of the drug should be utilized. Although the intramuscular injection of 50,000 units of aqueous penicillin one-half hour prior to surgery builds up an adequate blood level, the twenty-four hour preoperative dosage will probably do even more. The latter may give an added prophylaxis by decreasing in numbers the susceptible bacteria which may be forced into the blood stream. The lessened number of bacteria at the portal of entry and those organisms that may be in the process of inactivation can be made bacteriostatic more readily when the penicillin is given before the operative procedure. Penicillin administered on the day of surgery should be sufficient in dosage to maintain a high effective blood level until the agent is injected the following day. This also maintains the blood level for an additional twenty-four hours where it continues its desired bacteriostatic action.

The need for continued penicillin therapy following surgery, even though a bacteremia is transient in character, gives an added assurance that this agent has sufficient time to inactivate susceptible and potentially damaging pathogens until the body defense mechanisms can eliminate or destroy them.

Bull[41] and Wright[42] have shown that when relatively enormous numbers of slightly virulent and virulent organisms were injected intravenously into dogs and rabbits, there was a sharp, progressive fall in the number of bacteria in the circulating blood until the fifth hour. This is followed by a secondary rise in the number of bacteria from the fifth to the twenty-fourth hour and is caused by the capacity of the organism to multiply after the initial rapid clearing mechanism has acted. In the slightly virulent strains, the clearing mechanism then removes the newly formed bacteria at a greater rate

41. Bull, C. G., A Method for Estimating the Bacteria in the Circulating Blood in Rabbits. *J. Exper. Med.* **20**:237 (Sept.) 1914.

42. Wright, H. D., Experimental Pneumococcal Septicemia and Antipneumococcal Immunity. *J. Path. & Bact.* **30**:185 (April) 1927.

than they can be produced, the blood becoming sterile by the ninety-sixth hour. They further show that in the highly virulent strain, although the clearing mechanism removed over 97 per cent of the number of organisms by the fifth hour, multiplication then takes place and overwhelms the defensive mechanisms of the host. Topley and Wilson,[43] in discussing these findings, point out that the introduction of enormous numbers of bacteria in the blood stream would occur in natural infections only in rare instances. They emphasize, however, that the most significant period is during the fifth and twenty-fourth hour after the blood stream invasion, when the fate of the host is being determined by the balance between the bacterial multiplication and the removal of the newly formed cells.

A further interesting thought is presented when Topley and Wilson state, "Even when the tide has for the moment turned decisively in favor of the host, it does not follow that there will be a complete sterilization of the tissues. Bacteria will have been caught up in the liver, spleen, and elsewhere, and there some of them may remain alive but relatively inactive for considerable periods of time."

The method by which bacteria are destroyed is not completely known. Topley and Wilson assert that the majority of bacteria are destroyed by phagocytosis through intracellular digestion. However, to assume that a phagocytosed bacterium is one completely destroyed is unwarranted. In explanation they mention that a phagocytosed bacterium may sometimes be protected against bactericidal substances. In addition, wandering phagocytes sometimes play a part in the spread of infection.

Although briefly discussed, this information is presented to emphasize the complexity of the body defense mechanisms, and for its importance in showing the need for prolongation of penicillin therapy following traumatic procedures in the type of patient under consideration.

PROPOSED PROPHYLACTIC THERAPY—Penicillin in adequate doses should be administered to all individuals with endocarditis and where there is the potential opportunity of a bacteremia. This treatment should be instituted, not only when traumatic procedures are to be performed but when any condition or disease exists whereby bacteria may invade the blood stream. This is especially true concerning inflammatory processes, whether it be of the upper respiratory tract, the accessory sinuses, middle ear, prostate, cutaneous surfaces or elsewhere.

It, therefore, becomes apparent that an endocarditis should be recognized especially when from a rheumatic or congenital cause. Since the patient usually will not volunteer to give this information, one must inquire routinely into the patient's past history. If from inquiry definite or suspected information suggests valvular disease, then prophylaxis is indicated.

The hospitalized patient can be saturated adequately by administering intramuscularly 50,000 units of aqueous penicillin every three hours. This treatment should be continued until recovery has been established.

In the surgical case, penicillin should be given twenty-four hours preoperatively and at least forty-eight hours following

43. Topley, W. W. C., and Wilson, G. S., *The Principles of Bacteriology and Immunity*, second ed. Baltimore: William Wood and Co., 1936, p. 818.

operation. The method advocated for the ambulatory patient may be employed in place of the intermittent aqueous injections. This procedure achieves satisfactory prolonged blood levels of penicillin; its cost is reasonable; technically its administration is not complicated and for the office or ambulatory patient it is of great practical value. There is less discomfort and inconvenience to the patient.

At present the preparations of procaine penicillin in oil are thought to be the most acceptable although other products are being, or will be, introduced which may prove to be superior.

Procaine penicillin is prepared in 1 to 10 cc. vials, with 300,000 units of penicillin and 0.125 mg. of procaine in each cubic centimeter. Injections of 300,000 units of this material establish a high level of penicillin and maintain an effective bacteriostatic action at the end of twenty-four hours in most cases. However, in some instances, desired levels are not obtained at the end of eighteen and occasionally the twelve hour period.[31] Therefore, if 300,000 units of procaine penicillin in oil are given it should be repeated in twelve or eighteen hours. If complete assurance of sustained high penicillin levels are imperative, either the drug can be given every twelve hours or the daily administration of a single dose of 600,000 units will suffice.

With the information now available, the following prophylactic measures are being observed in the penicillinization of the ambulatory patient with endocarditis when surgical procedures are necessary:

1. Procaine penicillin in oil or Duracillin 600,000 units (2 cc. administered in the deltoid or gluteal muscle twenty-four hours prior to surgery).

2. Same preparation and dose repeated at the time of operation.

3. This product in the same dosage is again repeated twenty-four hours after surgical procedure. Daily injections should be continued, giving the same dose, if oral sepsis is severe and healing does not readily take place, until the danger of bacteremia is over.

The procedure of injecting 600,000 units of penicillin in a single daily dose over a period of time as long as necessary would seem indicated in the prophylactic care of any patient with endocarditis when infectious processes exist in the oral cavity, in root canal and gingival treatment, or whenever there is a possibility of bacteremia.

■ *Summary*

The present trend of medical thought concerning the use of penicillin as applied to the field of oral surgery has been discussed.

Certain basic principles of penicillin have been presented in order to familiarize the dental practitioner with the present knowledge of this remarkable drug.

The clinical application of penicillin therapy in oral surgery procedures is considered. Penicillin medication in no way replaces the observance of sound surgical principles; however, emphasis is made concerning its value as a prophylactic agent. Although penicillin therapy should not be used routinely on every patient, many conditions warrant its use in providing increased safety and in obtaining better clinical results.

The problem of the prophylactic use of penicillin on all patients having endocarditis, when inflammatory processes exist or dental procedures must be performed,

is discussed in some detail. The present information stresses the imperative need of penicillin prophylaxis for this type of patient.

A satisfactory routine to be followed in the administration of penicillin during the management of the patient with endocarditis is proposed.

Super-oxygenation in nitrous oxide and oxygen anesthesia

■ *John W. Seybold, M.D., D.D.S., Denver*

By super-oxygenation of a patient at the start of anesthesia, the anesthetist is able to bring on anesthesia so smoothly that it resembles natural sleep. There are no abrupt changes from consciousness to the first, second and third stages of anesthesia. The patient drifts from one stage to another while maintaining good color and facial expression.

The author first saw this technic in the administration of nitrous oxide and oxygen in the office of Ralston I. Lewis of Chicago. The old Clark apparatus with a single valve was used. The patient was started on pure oxygen, and of course the body tissues became super-oxygenated before the nitrous oxide was introduced to them. This prompted the author to suggest to Doctor Lewis that the method be termed super-oxygenation.

It is taken for granted that those present at this clinic have had experience with nitrous oxide and oxygen anesthesia and know its symptomatology. Because of this, all efforts shall be directed toward an explanation of how to produce surgical or third stage anesthesia and maintain it for as long as desired by the use of nitrous oxide and oxygen as the basic anesthetic.

The subject will be presented under three headings in the order of their importance.

■ *Preoperative Considerations*

The patient's physical condition should be checked to determine the anesthetic risk involved. The patient's stomach must be empty; no food or drinks of any kind should be allowed for at least four hours preceding the anesthetic. If the patient is of the hysterical type, premedication is used. The adult is given pentobarbital sodium (Nembutal) gr. 1½. A child is given 1 or 2 teaspoons of Elixir Nembutal, then requested to lie down for a half hour or more. A friend or relative should remain with the patient for a short

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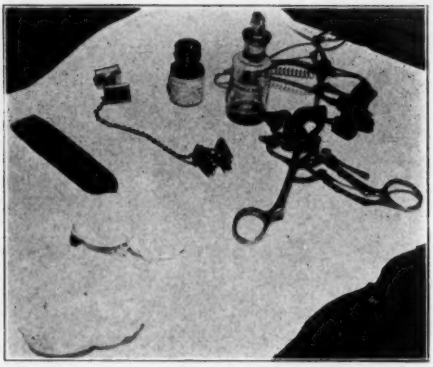

Fig. 1.—Equipment table on which is placed a small mouth prop, two throat packs with cotton cores in gauze coverings, a ratchet gag, a 10 cc. bottle of vinyl ether and a bottle of sweet orange oil

time and as soon as the premedication begins to act should be requested by sign or signal to leave quietly.

During this interval everything in the operating room has been made ready and the instruments are laid out and covered. On top of this cover these materials must be accessible: a small mouth prop, two throat packs with cotton cores in gauze coverings, a ratchet gag and a 10 cc. bottle of vinyl ether to be used as a synergist if indicated (Fig. 1). A restraining strap, 1½ inches wide and made of webbing such as that used for trunk straps, is snapped into metal loop on the far side of the chair (Fig. 2) out of sight. The nitrous oxide and the oxygen gage as well are set to a pressure of 60 pounds delivery to the anesthetic machine. If the patient is a child, the tension on the rebreathing bag is set for 5 mm., if an adult, it is set for 10 mm. The tension on the exhaling valve of the nose mask is at zero.

The patient is shown to the rest room to make himself comfortable and to avoid embarrassment caused by relaxation of the sphincters. Next, he is seated in the operating chair, and the back and headrest are adjusted so that the head and neck are in a straight line with the spinal column. The chair is tipped back to a 45 degree angle to distribute the weight equally on the seat, back and headrest, which tends to relax the patient and increase his comfort.

■ *Administration of Anesthetic*

The anesthetist then stands in front of the patient and says, "This will be a pleasant experience and I want you to keep your eyes open as long as you can. You will smell oranges and feel a pleasant glow pass over you, and you will hear music as you go to sleep." This is literally true, for the anesthetist touches the tip of the patient's nose with a finger that has sweet orange oil on it.

The nose mask is held above and approximately 6 inches away from the face, then gently lowered and allowed to rest on the nose without the administrator holding it. The flow of the gases, oxygen 100 per cent and nitrous oxide 0 per cent, is regulated to a gentle flow of 2 or 3 mm. so that the patient breathes without effort and is not conscious of its presence in the nose mask. After five or six breaths, the tension on the exhaling valve of the nose mask is tightened to 2 or 3 mm. to correspond with the flow of the gases. Simultaneously the oxygen percentage is being reduced steadily and the nitrous oxide percentage is being increased (large dial on the McKesson machine). It will soon be noted that the anesthetic is taking effect.

The anesthetist now says, "You are going to hear music." This is the signal for the nurse to turn on a concealed phonograph. The music is always a slow,

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dreamy waltz. By maintenance of the patient's normal color, the anesthetist will support metabolism at the same time and the patient will continue to breathe in a normal manner. Next the eyelid is gently tested for resistance. If resistance is still present, raise the flow of gases 1 mm. or more and at the same time correspondingly increase the tension of the exhaling valve on the nose mask. Note the coloring of the face. If it is dusky, raise the oxygen 1 or 2 per cent, using the small dial on the McKesson machine from this time on as it gives finer adjustment. If the face is bright red, reduce the oxygen 1 or 2 per cent. The aim is to maintain normal coloring. Next, note the position of the eyeball, which may be turned inward, downward or upward, or may be gently rolling from side to side, all of which indicates anesthesia is progressing normally. The respiration soon becomes abdominal in type, accentuated and regular.

The nose mask is now secured to the face with a head harness (Fig. 2) and the mouth opened. This usually is easy because the patient is properly oxygenated and relaxed. The left index finger of the surgeon is placed upon the base of the tongue, and with a slight downward and forward motion the tongue is brought forward. With his right hand the surgeon introduces the cotton covered throat pack upward against the hard palate and backward far enough slightly to engage the base of the tongue. This makes an airtight throat pack and does not interfere with respiration.

The position of the eyeball now should be centric, and the pupil smaller than normal, the color of the skin normal, respiration slightly accentuated and regular and facial expression relaxed.

The wrists are crossed and placed in a loop of the trunk strap (Fig. 2), and by pulling on the free end the hands are quickly secured. If the tension on the rebreathing bag has been set at 10 mm., and during the induction of anesthesia it has not been necessary to increase the flow up to 10 mm. (of course maintaining the same resistance on exhaling valve) and yet the surgical plane of anesthesia has been obtained, it will be noted that the rebreathing bag is not working, and will not work until the tension is lowered to that of the flow of gases being used. For instance, if the flow of gases is 5 mm., the tension on the exhaling valve of the nose mask should be at 5 mm. The tension on the rebreathing bag is turned back until the bag or bellows begins to open and shut with each respiration. This makes respiration easier.

The ratchet bar on the bellows is pulled up to the fourth notch and this causes the patient to rebreathe 400 cc. of

Fig. 2.—Operating chair, with restraining strap 1½ inches wide and made of webbing. This strap is kept out of sight until needed

used gases which contain carbon dioxide, a respiratory stimulant and still retain anesthetic potency. A 5 mm. intrapulmonary pressure of the anesthetic gases within the lungs is being created, which results in increased absorption of the gases, together with a deeper plane of anesthesia than would be possible with the same flow of gases without intrapulmonary pressure.

Let us suppose the patient is an adult and the previously mentioned technic has been followed up to a 10 mm. intrapulmonary pressure. But the patient, although anesthetized, is still tense and unrelaxed. This patient can be recognized as the stimulative type, or alcoholic. There are two things that can be done to "soften them up." One is to create a greater intrapulmonary pressure, 15 mm. or more, and literally overpower the patient with the gases. Another method is to use a synergist such as vinyl ether. I prefer a combination of the two and accomplish this by increasing the intrapulmonary pressure to approximately 15 mm. and placing 10 cc. of vinyl ether in the ether vaporizer. Open the valve slightly at first and gradually increase the strength of the vinyl ether and oxygen percentage between 15 and 20 per cent. After the patient has remained in a satisfactory plane of anesthesia for five minutes or more, the vinyl ether is shut off, continuing with the gas and oxygen.

A throat pack should not be allowed to become a soggy, slippery mass, as it excites the gag reflex. The pack should be changed often enough to avoid stimulation of the reflexes, and by so doing a smooth, even anesthetic will be effected. An uneven anesthetic results in nausea, headaches and postoperative discomfort.

The author's observations and experiences with general anesthetics has demonstrated that cyanosis, even duskiness, is not permissible or necessary with any anesthetic, including nitrous oxide and oxygen.

■ *Recovery Period*

At the conclusion of surgery, shut off the gases, pull the throat pack forward, or remove, clear all blood and mucus from the mouth and throat with suction, place a fresh pack over the operated area and release the ratchet gag partially. Remove the nose mask and allow the patient gradually to return to consciousness. Remove the ratchet gag and ask the patient to bite down on the pack covering the operative area.

■ *Summary*

The anesthetic should be started with oxygen 100 per cent and a 2 or 3 mm. flow with a gradual and progressive reduction of oxygen up to the point where eyelid resistance is lost. Use intrapulmonary pressure technic and flow of the gases to deepen or lighten the plane of anesthesia. The oxygen is used only to maintain normal color and support metabolism.—*Republic Building.*

■ RESEARCH SCHOLARSHIP

An annual scholarship of $1,000 for research in clinical oral pathology has been established by the New York Institute of Clinical Oral Pathology. Information can be obtained from the executive secretary of the Institute, G. Roistacher, 101 East 79th Street, New York 21.

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Cleft lip and palate

■ *A. L. Frew, D.D.S., Dallas, Texas*

The management of the cleft lip and palate is one of the most interesting phases of oral surgery because of its complexity and the gratification gained by satisfactory results. Good results are mandatory because of the prominence of the result.

■ *Embryonic Formation*

In review, the presence of the cleft lip depends on the failure of union of the maxillary process with the nasomedial process in the embryo. During the first month of life of the embryo, a depression occurs on the ventral surface of the head which deepens sufficiently to communicate with the cephalad end of the blind foregut. From the perimeter of this communication, the paired nasomedial, nasolateral and maxillary processes form and develop.

As they develop the maxillary and nasomedial processes approach one another, taking ascendancy over the nasolateral process on that side and, in the normal individual, fuse. The two nasomedial processes fuse, completing the arch of the upper jaw. The failure of union of the nasomedial process with the maxillary on either or both sides is responsible for single or double cleft lips.

The anterior portion of the palatal cleft derives its obliquity from the failure of union of the deeper surfaces of the nasomedial and maxillary processes. The middle and posterior portions of the palatal cleft are results of failure of union of the palatal shelf which arises from the medial aspect of the maxillary process on each side and which, in the normal individual, fuses with its fellow from the opposite side. This failure of union of the palatal shelves results in the constant midline position of the posterior portion of the palatal cleft.

The mechanism of production of the cleft lip and palate explains how the defects persist after their normal closure time but does not explain why there is this failure of union. In spite of numerous exhaustive studies the majority of cases are unexplained as to etiology, but heredity, with more accurate searching of the records, is found to be responsible for a larger percentage of cases than previously was thought.

The incidence of clefts varies according to racial groups, but as an easily rememberable figure one in a thousand is sufficiently accurate.

■ *Anatomic Review*

The lip, alveolus and palate clefts can occur singly or in any combination and can vary in severity from a tiny notching to a wide open cleft.

Anatomically, the lip consists of five layers which are, from within outward, the mucous membrane, submucous tissue containing the labial glands, the orbicularis oris muscle, the superficial fascia and the skin. The superior labial artery

Read at the thirtieth annual meeting of the American Society of Oral Surgeons, Chicago, September 10, 1948.

lies near the free margin of the lip and is a branch of the facial artery.

The hard palate consists of the palatine processes of the maxilla covered on both the nasal and oral surfaces by mucoperiosteum which, in the posterior part of the oral surface, contains mucous glands. The greater palatine artery, a branch of the maxillary artery, enters the palate through the greater palatine foramen and courses anteriorly, giving branches to the mucoperiosteum.

The soft palate is made up, in its anterior part, by the palatine aponeurosis covered superiorly by mucous membrane and inferiorly by a pad of mucous glands covered by mucous membrane. In its posterior part the mucous membrane on each surface covers five paired muscles—the palatopharyngeus, the palatoglossus, the musculus uvulae, the levator palati and the tensor palati.

A competent palatopharyngeal sphincter is essential for good speech, but adequate palatopharyngeal closure does not insure good speech because of other factors, one of which may be faulty speech habits acquired prior to the closure of the soft palate.

Probably the best way to illustrate this point is to choose two of the most common forms of clefts, the complete single cleft and the complete double cleft with protrusion of the premaxillary bone, and to list the steps in correction procedures.

■ *Correction of Complete Clefts*

Correction of the complete cleft is divided into three operations: first, the closure of the hard palate or alveolar ridge by the heavy-pressure wire method; second, plastic construction on the lip and nose, and third, closure of soft palate.

The first operation of closure of the alveolar ridge should be done at about 1 month of age. This operation is the most important of the three. It immediately puts the nose in the center of the face and brings the lip flaps and nostril closer together so that when the lip is operated on, there is a good full roll instead of a thin, flat lip.

In the case of a double cleft, with protrusion of the premaxillary bone, a section of the septum is removed, allowing the premaxillary bone to drop back into place, and the same wire pressure is used as in the single cleft. The wire is placed so that it holds the premaxillary bone in position and also brings the tuberosities closer together in a more normal relation to the mandible.

This closure of the alveolar ridge as just explained is condemned by some operators for various reasons. It is difficult, especially to the operator who has not had a large amount of oral surgery training; but to the oral surgeon who has worked constantly with the oral cavity it is not difficult—just a slightly different technic than one used in removing a badly impacted tooth.

■ *First Operation*

Cleft palate work belongs to the oral surgeon. Many operators will close a cleft lip over an unclosed alveolar ridge. The lip gradually will bring the alveolar ridge tips together, but there will be no union. The nose still will be deflected to the long side of the cleft. The nostril on the cleft side will be flat and the lip in most cases will be thin, leaving a condition difficult to correct esthetically in later life.

In the cases where the lip is closed over an unclosed alveolar ridge, the pressure of the lip will bring the incisal edge

of the ridge together; but higher up under the vestibule of the lip there will be an opening extending back under the floor of the nose. This opening is hard to get closed, is a cesspool for food and is impossible to keep clean.

When the hard palate is closed first, it eliminates the opening under the lip and gives tissue union to the alveolar ridge so that when the soft palate is closed it will give a complete closure of the whole cleft.

The important thing in the heavy-pressure method of closing the hard palate is placing the wires high up above the alveolar ridge in the maxilla. Because of the heavy pressure required to bring the bone together, it is necessary to be above the alveolar ridge; otherwise, it would strip the ridge from the bone.

The wires' position high above the ridge does not interfere with the tooth follicle, as is claimed by some operators. These wires are put in position by going through the bone first with a hand drill, then carrying pilot sutures of silk through, engaging the wires in the silk loops and pulling the wires through the maxilla.

Lead plates are fitted to the wires on the buccal sides; these plates keep the wires from cutting into the bone as they are twisted into place. The wires are placed so that the anterior parts of the alveolar ridge are brought completely in contact and at this point of contact are freshened so that they will grow together. At this early age the bone will yield to pressure, but in the older cases it is necessary to do a greenstick break in order to get the alveolar ridge together in the anterior part. The Brophy-Shearer greenstick fracture operation takes care of the adult cases nicely. Wires are left in the hard palate for six weeks.

■ *Second Operation*

The second operation or plastic on the lip and nose is done preferably when the patient is 4 to 6 months of age. The skin vermilion line is well defined, and the tissue is more firm than at an earlier age. A muscular dissection of the nostril and cheek on the cleft side is carried well up toward the eye and back over the tuberosity. This dissection allows the ala of the nose and the lip to be brought into place without stretching and gives a full roll to the vermilion of the lip.

On either side of the cleft, flaps are turned down to give a normal fullness to the lip at the cleft line. The suturing is started at the ala of the nose and worked down to the vermilion line, removing any excess of the flaps that were turned down from the tissue from either side of the cleft.

The same principle is used in the double cleft as in the single. Flaps are turned down on the right and left sides and these flaps are built around the middle peduncle that is a part of the columella. The width of these flaps determines the length and fullness of the lip.

After the lip is completed, a secondary support of adhesive strips is placed on either cheek connected by the Logan bow. This takes the strain off of the suture line. The sutures are left in for eight days.

■ *Third Operation*

The third or final stage is the closure of the soft palate or all that remains open from the alveolar ridge back to the uvula. For the past fifteen years it has been routine practice to have the tonsils removed at about 20 months of age. Then the palate is operated on two to three months after the tonsils have been removed. This

removes a source of infection. Also the tonsils are in the way of a secondary support of silver wires and lead plates which I use.

This operation consists of freeing the tissue from the palate plate on either side of the cleft back to the gingivae of the teeth. The margins of these free flaps are sutured together. These flaps must be approximated without any strain. In most cases they fail to come together freely, and relaxing incisions have to be made near the gingivae and around the tuberosity. This allows the flaps to be sutured without strain.

A secondary support of silver wires and lead plates is placed in the posterior part of the soft palate to take the strain off of the suture line. The sutures are left in the soft palate operation for a period of ten days.

In conclusion, this method of management of the cleft lip and palate problem has given gratifying results in a series of more than 3,000 cases.—*4105 Live Oak Street.*

■ Postgraduate Courses in Dentistry

The College of Dentistry of the Ohio State University is offering two series of postgraduate courses, one for the Winter Quarter and one for the Spring Quarter of 1949. Every effort is being made to enroll each applicant in the course or courses desired, but because each group is limited to ten students this is not possible in all instances. It is suggested that those interested apply early and give an alternate choice.

The courses offered for the Winter Quarter are: x-ray (H. D. Spangenberg, Jr.), January 10 to 14; oral pathology (H. B. G. Robinson), January 17 to 21; oral surgery (D. P. Snyder), February 28 to March 4; anatomy of the head and neck (L. F. Edwards), March 21 to 25.

The courses offered for the Spring Quarter are: periodontia (John R. Wilson), March 28 to April 1; oral pathology (H. B. G. Robinson), April 4 to 8; oral surgery (D. P. Snyder), April 11 to 15; partial dentures (Victor L. Steffel), April 18 to 22; children's dentistry (Lyle S. Pettit), May 2 to 6; full dentures (Carl O. Boucher), May 9 to 13; crown and bridge (Frank C. Starr), May 16 to 20; x-ray (Harry D. Spangenberg, Jr.), May 23 to 27; anatomy of head and neck (Linden F. Edwards), June 13 to 17.

The charge for the oral surgery course is $100; the fee for each of the other subjects is $50. Each course is given for five consecutive days. Monday through Friday. All of this work has been approved by the Veterans Administration, and veterans may have their fees paid under the G.I. Bill of Rights if they present their Certificates of Eligibility when registering for the first time. Civilian dentists are required to send a deposit of $25 with their applications.

Further information and application forms may be obtained from the Postgraduate Division, College of Dentistry, The Ohio State University, Columbus 10.

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Sialolithiasis

■ *Emil F. Tholen, M.D., D.D.S., Los Angeles*

The gratifying results following the successful removal of salivary calculi merit consideration of this problem. Five years ago, I reported to the Trilogical Society[1] in a paper based on the clinical study of 91 cases of salivary calculi. Since then, we have encountered 24 more cases. In this paper, the findings on the whole group will be summarized.

Case reports of sialolithiasis are quite numerous in medical literature. The etiology has been variously ascribed but is still uncertain. There are two main theories to be considered. According to the first, the inflammatory processes in the gland itself cause the formation of calculi. One supporter of this theory is Hanszel.[2] He believed epithelial cells of the glands and their ducts, which are destroyed under the influence of salivary congestion, are likely to collect in lumps and so form a nucleus upon which inorganic salts present in the saliva can be crystallized out and deposited.

According to the second theory, the calculi are the result of bacterial and fungus infection. The predisposing causes are conditions which augment the virulence of buccal organisms, that is, defective oral hygiene, general and local disease, salivary stasis and any cause tending to modify the hydrogen-ion concentration and the constituency of the saliva. This theory is supported in the studies and investigations of Maas[3] and Klebs[4] and more recently Naeslund[5] and Söderlund.[6] The last two have made extensive studies in this field and each is quoted by the other. Söderlund first associated salivary calculi formation with actinomycotic infection and later reported 41 cases in which Actinomyces was present.

In 1929, Naeslund reported his own experimental studies and his findings in 50 cases. These supported Söderlund's views. If the actinomycotic theory of calculi formation is true, one would expect to see an occasional case of actinomycosis of the gland itself. None of our cases showed any clinical evidence of actinomycosis.

The foreign body theory was advanced by Mareau.[7] He suggested that a fragment of tartar, seed, fish bone or a toothbrush bristle may find its way into a duct and thus form a nucleus for stone formation. The foreign body may act as an irritant and cause inflammation of the duct.

New and Harper[8] state that saliva

Read at the thirtieth annual meeting of the American Society of Oral Surgeons, Chicago, September 9, 1948.

1. Tholen, Emil, Calculi of the Salivary Glands. *Tr. Am. Laryng., Rhin. & Otol. Soc.* 35:1941.

2. Hanszel, F., Ueber Speichelsteinbildung. *Wien. klin. Wchnschr.* 13:160, 1900.

3. Maas, Oscar, *Die Schweninger-Kur. Diatetische und Entfellungs.* Berlin: H. Steinitz, 1888.

4. Klebs, E., *Arch. f. exper. Path. u. Pharmakol.* 5 and 6, 1876.

5. Naeslund, Carl, Fortgesetzte Untersuchungen über die Speichelsteinbildung unter besonderer Berücksichtigung ihres Verhältnisses zur Entstehung primärer Speicheldrüsenaktinomykose. *Acta path. et microbiol. Scandinav.* 6:78, 1929.

6. Söderlund, Gustaf, Die Speichelsteinkrankheit ("Sialolithiasis") und ihr Verhalten zu der primären und duktogenen Speicheldrusenaktinomykose. *Acta chir. Scandinav.* 63: supplement no. 9, 237 pages, 1927.

7. Mareau, Gustave, *Etude sur les calculs salivaires du canal de Warthon et de la gland sousmaxillaire.* Paris, 1876.

8. New, G. B., and Harper, F. R., Chronic Inflammation of the Salivary Glands with or without Calculi. *Surg., Gynec. & Obst.* 53:456 (October) 1931.

from the submaxillary glands contains a higher percentage of solids and organic matter and has a greater degree of alkalinity and a lower content of carbon dioxide than the saliva of the parotid or sublingual glands.

Certain anatomic peculiarities predispose the submaxillary gland to calculi formation. These include irregularities and diverticuli in the excretory duct. These irregularities serve as sites for secretory stasis and colonization of microorganisms with eventual stone formation. The first diverticulum of this kind is located 0.17 mm. below the caruncular surface; they are located rather close together, are quite numerous and begin to decrease in number about 12 mm. from the orifice.

■ *Symptoms*

The symptoms may be acute, subacute or chronic. The acute form is usually sudden in onset but may be preceded by one of the other types. The patient complains of pain, soreness and swelling of the soft tissues about the gland and duct and often shows a purulent discharge. The ductal papilla may be red and edematous. The general symptoms that usually accompany acute inflammatory disturbances may also be present.

The subacute type shades into the other forms clinically. The chief findings are enlargement of the gland while eating and a flocculent discharge from the duct. A calculus frequently can be palpated or it may be located by needling.

Chronicity occurs when the condition is not relieved by removal of the stone. This stage is characterized by suppuration of variable amounts and intermittent clinical symptoms. The calculus tends to dam up the saliva and act as a local irritant. When it grows large, the patient becomes conscious of it. Repeated probing of the ducts is of little help and may cause trauma and produce secondary infection.

A survey of our cases showed that 97 occurred in the submaxillary gland and duct, 14 in the parotid gland and four in the sublingual gland. Of the 115 cases, 84 came to surgery. Seventy-one calculi were removed from the submaxillary region, nine from the parotid and four from the sublingual. In five cases, the submaxillary gland was excised.

There was a wide variation in age incidence, the oldest patient being 76 years of age, three patients being over 70 years old. The youngest included in the series was 11 years old. The majority of patients were in middle life. In the last five years, there were six cases in patients who were over 50 years old. The ratio of males to females was about 2 to 1. Multiple calculi were encountered in 14 cases.

The calculi varied in size from that of a pinhead to 1¼ inch in length. One was removed from the Wharton's duct of a Negro physician. It was 1 inch in length and ¼ inch in diameter.

The duration of symptoms was quite variable. One patient had intermittent pain in both parotid glands for thirty-six years. The longest duration of a submaxillary case was twenty-five years and five cases lasted over ten years. There were some patients in which symptoms were present for only a few days. These short periods occurred in cases of acute obstruction with infection.

An interesting condition was noticed in this series: Bilateral submaxillary calculi were seen at roentgenographic examination in one patient and were removed about ten years ago. The patient

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had a bilateral recurrence five years later.

In one instance, the removal of a submaxillary calculus was followed by mild obstructive symptoms of the parotid gland on the same side. These symptoms disappeared by the spontaneous discharge of several minute calculi from the Stenson's duct.

Two cases were found in which the major portion of the submaxillary gland had been excised for obstructive symptoms in other institutions. In both of these cases we subsequently removed calculi through the oral route from the remaining portion of the gland. In one of these cases the gland had discharged through an oral sinus for nine months following external surgery.

In a case of acute obstruction and suppuration of a submaxillary gland, an external incision and drainage was done. Following the acute process perioral removal of a calculus was attempted. The calculus was exposed but was lost in the fascial planes of the floor of the mouth and moved into the neck. The usual type of neck incision was made, and the stone was positioned to immediately above the hyoid bone and removed.

Spontaneous discharge of calculi occurred in eight cases, either through the duct or through a fistula. In one case of a parotid stone, probing of Stenson's duct produced the discharge of the stone.

Roentgenographic examination of the submaxillary region, the floor of the mouth and Stenson's duct usually will reveal the stone. This does not hold true for roentgenograms of the parotid gland. The diagnosis may be aided by iodized poppyseed oil (Lipiodol) injections.

In the differential diagnosis of an enlarged salivary gland, one must consider benign and malignant tumors, infectious granuloma, actinomycosis, parotitis, syphilis, ranula, lymphadenitis and cellulitis.

■ *Treatment*

The treatment varies with the conditions present and the complications involved. Parotid duct calculi usually are removed by opening the duct from the mouth. If they are in the gland, the incision must be made externally and great care taken to avoid the facial nerve. The stone is usually small and deeply seated. It must be definitely localized; otherwise, failure will result. One patient who had repeated attacks for a period of ten years finally developed an acute abscess which was incised externally. One week later, the calculus was removed through this opening after three hours of work. The operation produced pain in the parotid gland and a small mass behind the lobe of the ear. The patient was given roentgen therapy and made a complete recovery in two months.

Calculi in the floor of the mouth usually can be removed by incisions over them. If the stone is small and in the submaxillary gland, it is advisable to wait until it moves into the duct. Progress usually is hindered at the turn of the duct around the posterior border of the mylohyoid muscle. At this site, it is accessible and can be removed. In cases of acute obstruction, the duct often is distended in this region and the patient can be given great relief by incising it. The stone will at times be expelled with the obstructed fluid. However, if it does not come out, it should be removed when the tissues regain their normal tone. Acute inflammatory symptoms must have palliative treatment before removal of the stone. This

consists of penicillin or sulfonamides, hot mouth irrigations, cold external applications, liquid diet and sedatives. The smaller stones are more difficult to remove. Care must be taken to avoid cutting the lingual nerve or a deep-seated vessel or severing the duct. The stone is made accessible by upward pressure on the gland. It should be prevented from shifting backward by the use of a wire suture.

The submaxillary gland should be removed if it is continually large and tender and contains the stone, also if it is the seat of degenerative changes or if the stones are multiple. In approaching the submaxillary gland, the incision should be made well below the border of the mandible; otherwise, the lower branches of the seventh nerve will be severed and cause a drooping lip.—*1136 West Sixth Street.*

■ Academy of Cleft Palate Prosthesis

The seventh annual meeting of the Academy of Cleft Palate Prosthesis will be held in Columbus, Ohio, at the College of Dentistry, The Ohio State University, on March 21 and 22, 1949.

■ The American Board of Oral Pathology

The American Academy of Oral Pathology, as sponsoring agency, announces the formation of the American Board of Oral Pathology. This board is incorporated in the District of Columbia and has been organized in accordance with the policies established by the Council on Education of the American Dental Association.

The members of the board are: Lester Cahn, New York City, president; Hamilton B. G. Robinson, Columbus, Ohio, vice-president; and Lt. Col. Joseph L. Bernier, Washington, D. C., secretary-treasurer. The Board of Directors, in addition to those serving at present, consists of Kurt H. Thoma, Boston; Paul E. Boyle, Philadelphia; Donald A. Kerr, Ann Arbor, Mich., and Henry M. Goldman, Boston.

Detailed information as to eligibility for certification and character of the examination may be obtained by writing the secretary, Lt. Colonel Joseph L. Bernier, D.C., Army Institute of Pathology, Washington 25, D. C.

The Board will conduct its first examination in the fall of 1949. Full particulars on this examination will be published at a later date.

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Gunshot fracture of the mandible:

report of case

■ *Douglas B. Parker, M.D., D.D.S., New York*

HISTORY—A policeman, aged 30, was struck in the lower jaw by a bullet from an accidentally discharged 38 caliber revolver on June 22, 1944. There was a profuse flow of blood from his mouth, and he was rushed to the hospital.

EXAMINATION—The patient bled profusely. There were three openings in the skin. One was on the right side of the mandible, about 1 cm. above the lower border, at the level of the first bicuspid. It was rounded and was about 5 cm. in diameter with irregular edges. There were no powder marks around this opening, which was probably the point of entry of the bullet. The second wound was about 1 cm. above the point of the chin and was about 3 cm. in diameter with everted edges. It seemed to be the wound of exit. In the submaxillary region on the left side there was a 1.5 cm. cut with straight edges at the level of the corner of the mouth. It may have been another wound of exit.

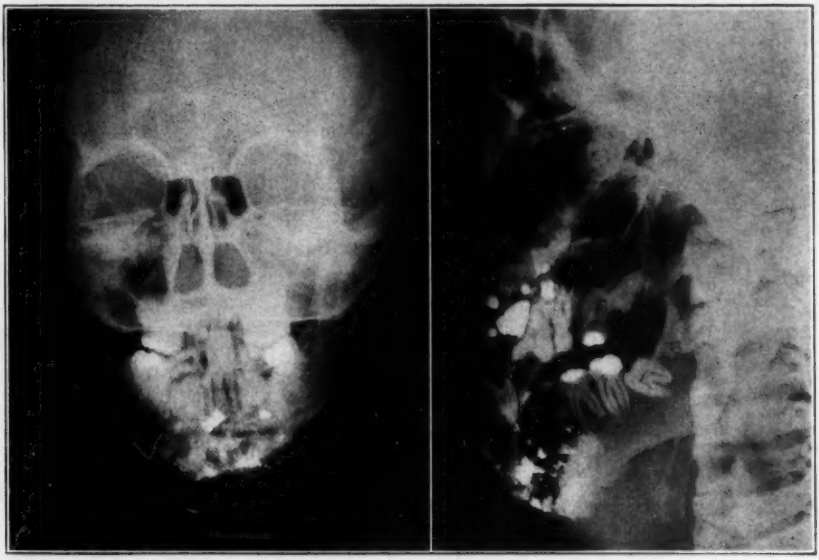
Inside the mouth on the right side there was a cut in the alveolar border between the cuspid and the first bicuspid, corresponding to a fracture line in the mandible. On the left side there was another cut between the central and lateral incisors, also corresponding to a fracture line. There was swelling in the submaxillary region, especially on the left side, caused by hematomas. The patient had a compound comminuted double fracture of the mandible. Main fractures appeared to be on the right and left sides near the cuspid-bicuspid regions. There was marked swelling, oozing and edema in the floor of the mouth and under the chin. The anterior segment was pulled downward and backward into the hyoid group of muscles.

The patient's blood pressure was 160/90 and his pulse was 90. Tetanus antitoxin 1,500 units and one therapeutic dose of gas gangrene antitoxin were administered. Morphine sulfate ¼ grain was given at 2:20 a.m.

ROENTGENOGRAPHIC REPORT—Anteroposterior and lateral roentgenograms of the mandible disclosed numerous irregular shadows of metallic density superimposed upon the shadow of the mandible close to the midline. The whole region involved was about 6 cm. in diameter. The lower margin of the anterior portion of the mandible appeared to be fractured. Within the large fracture fragment there appeared to be numerous comminutions. There had been little if any displacement of the bone fragments. In the lateral projection numerous small metallic fragments were seen lying in the anterior portion of the floor of the mouth (see illustration).

LABORATORY REPORT—Cultures of drainage material from the three wounds in the skin were made on June 22, 1944, and disclosed: center and left side, aerobic: Staphylococcus albus and Streptococcus viridans; anaerobic: none; right side, aerobic: Staphylococcus albus and hemolytic Bacillus subtilis; anaerobic: none.

TREATMENT—In order to control the flow of blood from the compounded regions it was thought best to wire the adjacent fragments together temporarily. The teeth wired together



Left: Anteroposterior roentgenogram, showing multiple comminutions of symphysis and fragments of bullet. Right: Right lateral roentgenogram of mandible, showing multiple fractures of symphysis and retained fragments of bullet

were the right cuspid and bicuspid and the left central and lateral incisors. All four fragments had to be fixed again at a later date. The slight traction had to be reduced, the parts stabilized and the bleeding reduced. The patient's mouth was irrigated with hot saline solution every hour. It was planned to construct an intraoral splint as soon as possible after reduction of the parts. No attempt was made to remove foreign bodies at first. Suppuration was expected to follow with probable later incision and drainage.

On June 23 the wound was dressed and a rubber dam drain was inserted in two wounds in the mental area for more adequate drainage. The lip was swollen and ecchymotic. There was a large degree of sanguineous oozing in the sublingual region. The gauze impregnated with petrolatum was removed and the wound was covered with sterile gauze. The mandible was supported by a traction bandage with elastics.

OPERATION—On June 26 the patient was given premedication of morphine sulfate ¼ grain. Olinger labial arch bars were fitted to the labial surfaces of the patient's maxillary and mandibular teeth. These arch bars were wired to individual teeth by stainless steel wire. The lower anterior teeth were manipulated into alinement and wired to the arch bars. Individual elastic bands were used for upward and backward traction to bring the lower teeth into a better occlusal relationship. The patient stood manipulation well.

PROGRESS — Penicillin was administered during the patient's stay in the hospital until July 3. A total of 2,375,000 units was given. The application of elastics for traction gradually pulled the lower anterior teeth into very good alinement. Previously it had been difficult to get the anterior teeth closer than 1 cm. from the upper incisors. The teeth gradually tightened and all intraoral drainage ceased by July 1. The patient was discharged from the hospital. He was seen every other day for irrigation of his mouth and adjustment of the elastics. No infection was present until July 17, when

a small region under the chin showed reddened swelling. It was necessary to incise the region and drain a small amount of pus. A roentgenogram showed the bone to be in good relationship, and occlusion of the teeth was excellent.

COMMENT—This patient was given massive doses of penicillin, well beyond the dosage in ordinary uses. Early temporary stabilization of the fractured parts by interdental wiring undoubtedly aided in minimizing the infection which inevitably would be expected to result from a gunshot wound with such extensive comminution of the symphysis. No effort was made to remove any of the bullet fragments although there were two fairly large pieces of lead which will undoubtedly have to be removed at a later late. The main splintered fragments of the bullet will become encysted and probably will be harmless. It would be almost impossible to remove these minute particles.—*121 East Sixtieth Street.*

Osteomyelitis of the mandible:

report of case

■ *Douglas B. Parker, M.D., D.D.S., New York*

A white man, aged 28, who was a dentist practicing in Colombia, S.A., had a lower right first molar extracted under local anesthesia. It was apparently a clean extraction but was followed by an acute infection with pain, swelling and fever, necessitating the patient's hospitalization and repeated incisions and drainage for the osteomyelitis which developed in the right side of the mandible. The patient was hospitalized for five months but made very little improvement. Becoming discouraged by the prolonged treatment, he flew to the United States. He arrived in ambulatory condition and was admitted to the hospital on July 12, 1943.

EXAMINATION—The patient showed a marked enlargement of both sides of the face, particularly over the posterior portion of the mandible and over the ramus. He showed multiple scars along the lower border of the right side of the mandible and a few old scars about the angle of the left side of the mandible. There were several discharging fistulous tracts in the right submaxillary triangle below the angle of the jaw (see illustration). His temperature on admission was 100.4 F. A complete blood count was made immediately and showed: hemoglobin 92 per cent; red blood cells 5,200,000; white blood cells 13,000; polymorphonuclear leukocytes 68 per cent; lymphocytes 25 per cent; monocytes 3 per cent; eosinophils 3 per cent, and basophils 1 per cent.

ROENTGENOGRAPHIC EXAMINATION—The following roentgenographic findings were reported on July 12, 1943: Examination of the mandible shows an extensive destructive process involving the entire right side. The ascending ramus is almost entirely destroyed, and there are several regions which could be sequestrums. It is difficult to estimate how far anteriorly the process extends, as there is a generalized decalcification, and the jaw is obscured by the large, soft tissue mass. The findings are compatible with an extensive osteomyelitis involving the right side of the mandible.

OPERATION—Sequestrectomy of the right side of the mandible was performed under Pentothal sodium anesthesia intravenously ad-

ministered. An incision was made posterior to the fistulae in the right submandibular region, extending down to the middle of the neck and up to the anterior side of this region. Thus, all this granulation tissue was removed. The appearance of the tissue mass suggested possible actinomycosis. A second incision was made through a scar which was located at the inferior border of the mandible in the region of the notch for the external maxillary artery. The incision was about 1¼ inches long. By blunt dissection through both incisions, the sequestrums were found and removed. From the latter incision a sequestrum the size of an acorn was removed, which proved to be the entire posterior border of the ramus from the angle to and including the head of the condyle. Rubber tube drains and iodoform gauze were placed in each incision and a dry dressing was applied. The patient had considerable difficulty in breathing under anesthesia, became quite cyanotic and had considerable spasm about the glottis. It was necessary to introduce a tracheal tube for adequate respiration.

PATHOLOGIST'S REPORT — The bone removed showed chronic osteomyelitis, but no evidence of malignancy.

PROGRESS—The patient had the wound on the right side dressed daily with gauze impregnated with zinc peroxide. Considerable swelling continued and increased over the left side of the mandible, making a second operation on the left side advisable. Roentgenographic examination revealed a sequestrum of the left side of the mandible in the region of the angle. The remainder of the pathologic condition was as previously described.

SECOND OPERATION—On July 21, 1943, sequestrectomy of the left side of the mandible was performed under Pentothal sodium and oxygen administered by nasal intubation. A 1 inch incision was made through a scar located in the region of the left angle of the ramus. By blunt dissection, a sequestrum 2 by 5 cm. was obtained and removed. A rubber drain and iodoform gauze were placed in the wound and a dry dressing was applied.

PROGRESS—Daily dressings were continued with rubber tube drainage and irrigation. Sulfanilamide paste was incorporated into iodoform packing which was placed in the wound next to the drainage tube. Drainage from both sides of the face gradually diminished and the patient was discharged from the hospital on August 21, 1943. Dressings were continued in the outpatient clinic, and the wounds had closed entirely by September 15. There was a degree of malocclusion of the teeth caused by shifting

Left: Right side of face, showing scars of incisions made in South America. Center: Front view of face, showing marked swelling at time of admission to hospital after five months of treatment in South America. Right: Appearance of left side of face at time of admission to hospital

of the jaw, which had occurred because of pathologic fracture on the right side. Further roentgenograms showed regeneration of bone along both rami. The patient was readmitted on December 1, 1943, for the removal of a cicatricial deformity at the site of previous incisions which had been made on the right side of the neck.

THIRD OPERATION — This operation was performed on December 1, 1943, under Avertin and anesthesia intranasally administered. On the right side of the neck there was a wide scar with keloid-like appearance, a portion of which was markedly retracted, leaving an unsightly deformity. There was a second scar, about 3 cm. in length, in the midline just below the symphysis of the mandible. The margins were inverted, leaving a very conspicuous depressed scar.

The entire area of scar was widely excised. The margin of the wound was undermined on either side of the incision for 2 to 3 cm. Deep sutures of catgut were employed to coapt the fascia along the length of the wound and to keep all tension from the skin coaptation. The skin wound was closed with interrupted dermal sutures. The scar was excised, the lateral portions undermined and the deep fascia everted to compensate for the depression created in the cicatrix. Catgut sutures were used for this purpose. The skin was closed with interrupted dermal silk sutures. A pressure dressing was applied over gauze impregnated with petrolatum in both of these wounds.

PROGRESS—The wound healed well with a minimum of scarring and almost no indentation. The result was cosmetically greatly improved. The patient was discharged on December 9, 1943. He returned to the outpatient clinic, and further operations for scars on the left side of the neck were performed under local anesthesia. The patient was referred for radiotherapy for a keloid scar under the chin in the midline, and was given 800 roentgens between January 3 and 14, 1944.

COMMENT—It is suggestive that the infection might have been caused originally by an infected hematoma after injection of an anesthetic for extraction of the tooth. It is apparent that the original incisions made when the patient was in South America were inadequate for the best drainage, and that sequestrums which had formed could not be expelled or removed from the small openings that were present when we first saw the patient. Adequate incision and drainage, removal of numerous sequestrums and local chemotherapy in the wound apparently were adequate to clear up the osteomyelitic infection. Sufficient time was permitted to elapse after the disappearance of infection before the unsightly cicatrices were removed, and a more cosmetic appearance was obtained.—*121 East Sixtieth Street.*

■ GRADUATE COURSE IN BASIC SCIENCES

A two-year, full-time graduate course in the basic sciences, with limited clinical experience, is being offered by the Graduate School of the University of Illinois through the Department of Oral and Maxillofacial Surgery. It will carry credit toward a Master of Science degree. Applications are being accepted now for September 1949.

Further information can be obtained from the Department of Oral and Maxillofacial Surgery, College of Dentistry, University of Illinois, 808 South Wood Street, Chicago 12.

Repair of antro-oral fistula:

report of case

■ *Richard J. Burch, D.D.S., Urbana, Ill.*

A man, aged 27 years, came to the station hospital at March Field, California, on March 12, 1946, complaining of an opening from the mouth into the left antrum through which food and fluids passed, causing considerable discomfort and annoyance.

HISTORY—Upon clinical examination, August 24, 1945, a residual root was found in the left maxillary first molar region. It was removed with some difficulty, but there were no undue postoperative complications. On or about October 15, 1945, the patient had contracted severe coryza with considerable drainage from the sinuses and with associated severe headaches. Shortly afterwards the patient noticed a "dropping" of the tissues, followed by drainage, in the region where the root had been removed. His dentist gave him local treatments for about two weeks.

The severe headaches continued and on November 16, 1945, he consulted a physician who prescribed immediate operation on the antrum, which was done on November 18. Apparently a Caldwell-Luc operation and intranasal antrostomy were performed. The postoperative course was not unusual except that the oral opening into the antrum at the site of root removal failed to close.

EXAMINATION—In the left mucobuccal fold superior to the maxillary first molar region was

Lieutenant colonel (temporary), U. S. Army; now assigned to the Section on Oral Surgery, Carle Hospital Clinic, Urbana, Illinois.

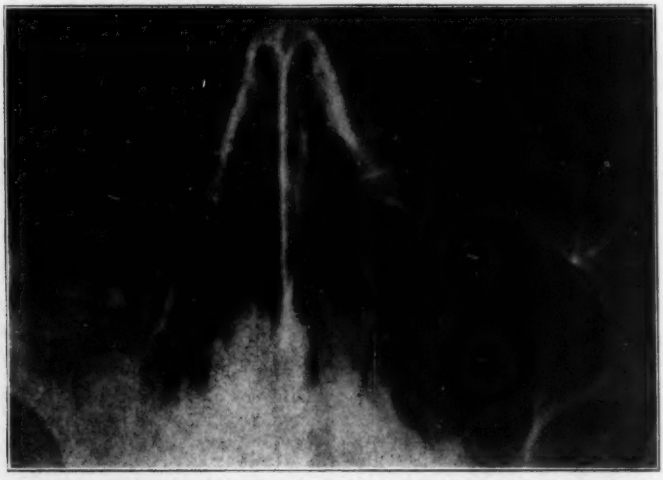


Fig. 1.—Roentgenogram of the maxillary sinus. Note cloudiness of the left antrum, indicating possible thickening of the antral membrane

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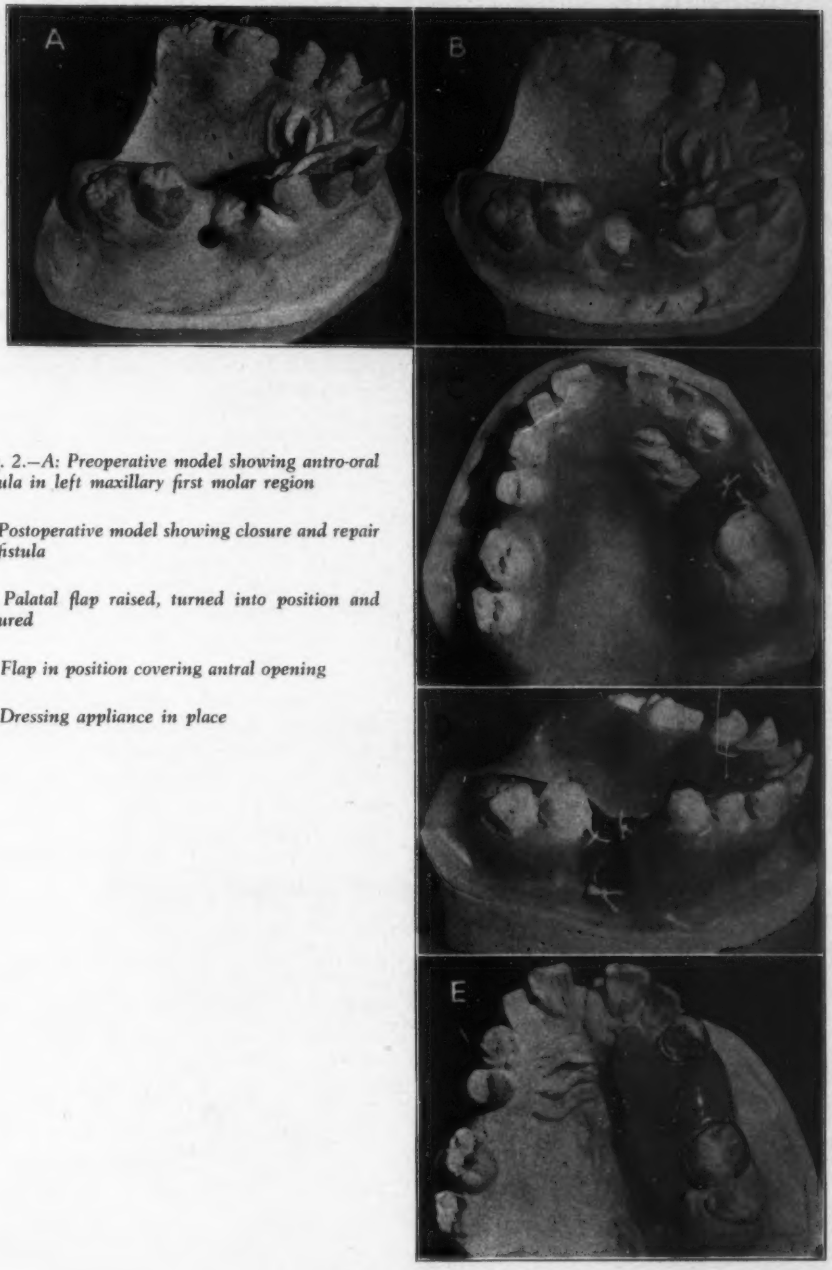

Fig. 2.—A: Preoperative model showing antro-oral fistula in left maxillary first molar region

B: Postoperative model showing closure and repair of fistula

C: Palatal flap raised, turned into position and sutured

D: Flap in position covering antral opening

E: Dressing appliance in place

an antro-oral fistula, completely epithelized, measuring approximately 5 mm. in diameter. In the canine fossa the mucosal cicatrix indicated the site of previous operative interference. The intranasal opening into the left antrum was patent and offered good drainage. Roentgenographic examination revealed a definite thickening of the left antral membrane (Fig. 1). This was believed to be the result of previous infection and/or surgery. No foreign bodies and no infection were apparent at this time.

PREOPERATIVE TREATMENT—After the model was studied (Fig. 2, A), a dressing appliance was constructed. The model was built up to allow for postoperative swelling before the appliance was constructed.

The patient was admitted to the hospital on April 29, 1946. His reaction to the Kahn test was negative. The erythrocyte count was 4,800,000 per cubic millimeter; the leukocyte count 6,700 per cubic millimeter, and hemoglobin 14 Gm.

On April 29 and 30, the left antrum was irrigated with normal saline and an iodoform gauze pack was used in the antro-oral fistula to prevent food and fluid from entering the sinus.

Penicillin (20,000 units) was given every three hours intramuscularly, beginning six hours before operating time and continuing until a total of 300,000 units was reached. An hour and a half before the operation morphine gr. ¼ and atropine gr. 1/150 were given.

OPERATION—The anesthetic used was 2 per cent procaine, infiltrative. A palatal flap was outlined by definite incision but not elevated. A *V*-shaped section of tissue was incised and removed immediately mesial to the maxillary second molar. A vertical incision was made from the inferior border of the fistula opening to the edge of the palatal flap. The buccal mucosa and periosteum were elevated from the gingiva.

The epithelial lining of the fistulous tract was dissected and completely removed. The antral membranes were lightly freshened. The opening in the bone was approximately 8 mm. in diameter.

The palatal flap was raised. A mattress suture was taken in the end of the flap, which was then turned into position to cover the osseous opening into the antrum. The suture was completed through the buccal tissue superior to the opening (Fig. 2, C and D). The buccal tissue was returned to position and sutured to the flap mesially and distally with two sutures.

A dressing splint lined with gauze was saturated in bismuth, iodoform and petrolatum paste[1] and inserted.

POSTOPERATIVE TREATMENT—The dressing was changed after forty-eight hours and the mattress suture removed. The splint was discarded as dressing on the fifth day, and the remaining sutures were removed.

The patient used a penicillin mouth wash (100,000 units to 120 cc. of normal saline) every three hours during the day for seven days. He was discharged on May 13, 1946 (Fig. 2, B).

COMMENT—In the repair of antro-oral fistulas following acute infection of the sinus, the presence of an intranasal opening is most important for permanent closure and should not be attempted otherwise.

Successful closure of an antro-oral fistula is largely dependent on complete preoperative planning.

The method of closure selected in this case was predicated on the concavity of the bone in the area of the osseous opening into the sinus. Utilizing this type of flap assured definite continuous contact between the tissue repairing the defect and the surrounding bone during healing.

1. Bismuth subnitrate, 1 part; iodoform, 2 parts; sterile petrolatum, 3 parts.

Excision of areolar hyperplasia with electrocautery:

report of case

■ *Daniel J. Holland, Jr., D.D.S., Brookline, Mass.*

The labial and buccal areolar gingivae are particularly sensitive to mechanical irritation and react by producing hyperplasia. These are not true neoplasms but are localized inflammatory folds or excesses of oral mucosa. Although they are easily recognized, pathologic examination is indicated to rule out the possibility of a malignant tumor. Ill-fitting dentures and irritating bridges are the common etiologic factors in such tumefactions.

HISTORY—A woman, aged 57 years, entered the dental clinic, having been referred by her local dentist with a 1 by 1 cm. soft, nontender, nonulcerated, smooth, pedunculated mass in the buccal sulcus of the lower left second molar region. The mass was discovered when her dentist removed a loose fixed bridge one week previously. He had told the patient it was a "tumor" and the woman entered the clinic apprehensively with the idea she had cancer of the mouth.

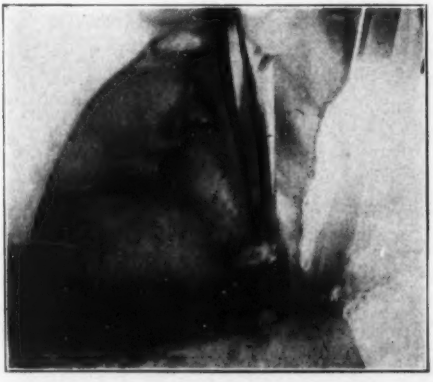

Fig. 1.—Excision of papillomatous mass with cutting current point

Fig. 2.—Surgical defect after excision, painted with tincture of benzoin

OPERATION—Under local anesthesia, the mass was excised with an endothermic needle. Small bleeding points were coagulated and the exposed surface was painted with tincture of benzoin.

The pathologic examination of the excised mass showed capillary granulation tissue and fibrous connective tissue with inflammatory proliferation of the epithelium.

DIAGNOSIS—Areolar hyperplasia—chronic inflammation.

COMMENT—Surgical diathermy is a satisfactory method of excising benign, pedunculated epulides in the oral cavity.—*1080 Beacon Street.*

Chemotherapy of osteomyelitis of the mandible:

report of case

■ *Anthony J. Karpawich, D.M.D., Worcester, Mass.*

On March 21, 1947, a man, aged 33 years, presented himself with the complaint of a severe unlocalized ache of jaws, ears and face.

HISTORY—His medical history was essentially negative. About two years previously, he had been confined for a period of four months in a Naval Hospital with phlebitis of the left arm.

For six weeks before he sought advice, he had been having severe headaches, earaches and piercing pains of the temporomandibular joints. They never had localized although they appeared more frequently on the right side. They were worse at night. Since their onset he had been extremely nervous, had anorexia, malaise, and as a result had lost 30 pounds in weight.

There was no history of any toothache or trauma to the jaws or head. He had consulted several physicians and obtained no relief. About a week previously, the pain had occurred in the jaws as well, which prompted him to seek dental advice.

EXAMINATION—Although the patient was 6 feet 3 inches in height, he weighed only 165 pounds. His face was drawn and he exhibited great anxiety. Oral examination disclosed his mouth and gums to be in good condition. The teeth were well cared for, not sensitive to percussion, and all responded to a vitality test except the lower right first biscuspid.

Intraoral roentgenograms disclosed a slight resorption of the lower anterior alveolar crest, but the gingivae were firm and healthy. The lower right first biscuspid had a periapical lesion. In the roentgenograms of the mandible, there appeared to be a disturbance of the intraossous structure; namely, an enlargement of the medullary spaces in the symphysis which presented a mottled appearance and suggested the possibility of an incipient osteomyelitis.[1]

The blood pressure was 128 mm. for the systolic and 76 mm. for the diastolic pressure. His temperature was normal, and there were no swellings of the face. There was no cervical adenitis, and other characteristic symptoms were lacking.

OPERATION—On March 24, 1947, it was decided to extract the lower right first bicuspid, using a mandibular block anesthesia. It was accomplished without undue traumatization, and a rubber dam along with penicillin powder was inserted in the socket in the hope of establishing drainage. The drains were changed and the wound was irrigated frequently. Postoperative healing was uneventful. There was no show of pus. For several weeks, his symptoms subsided and then abruptly returned as severely as ever.

LABORATORY EXAMINATION—On April 4, he was referred for a complete blood count, also a blood calcium determination to rule out any possible parathyroid abnormality. The laboratory findings were: 17,600 leukocytes per cubic millimeter with 80 per cent polymorphonuclear neutrophils. The urine and Hinton test reactions were negative. The blood calcium was within normal limits. His temperature was 99.4 F.

Additional roentgenograms disclosed further destruction of bone. The diagnosis was established of mandibular osteomyelitis caused by odontogenic infection of the lower right first bicuspid. There still was no swelling or suppuration present.

1. Thoma, Kurt, *Oral Pathology*. St. Louis: C. V. Mosby Company. Second edition.

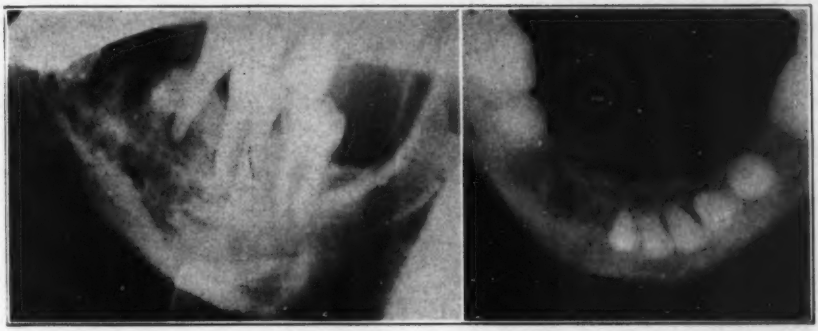

Fig. 1.—Left: Lateral view of jaw showing typical moth-eaten appearance of osteomye'itis of the mandible (May 1, 1947). Right: Occlusal view. There appears to be sequestrum formation on the lingual aspect of the mandible (May 15, 1947)

He was averse to hospitalization, and penicillin 50,000 units (oral tablet) every three hours was prescribed. He was given sedatives for relief of pain, and general supportive treatment was continued for about three weeks.

During this time the lower right lateral incisor and cuspid became devitalized and were extracted with the patient under nitrous oxide anesthesia. Most of the lower anterior teeth were now mobile and sensitive to percussion. However, at no time was there any evidence of suppuration either from the sockets of the extracted teeth or from the jaws.

Later roentgenograms began to show more osteolytic changes with the possible formation of a sequestrum on the lingual aspect of the inferior border of the mandible (Fig. 1, right).

On April 24 he was admitted to the hospital with an indurated, nonfluctuant swelling under the chin in the symphysis region. It was of several days' duration. At the time of admission his temperature was 100.2 F. The leukocyte count had risen to 19,600. All other tests were negative.

TREATMENT—The patient was placed on a nutritious diet of high caloric intake and multivitamin therapy. Fluids were forced, catharsis

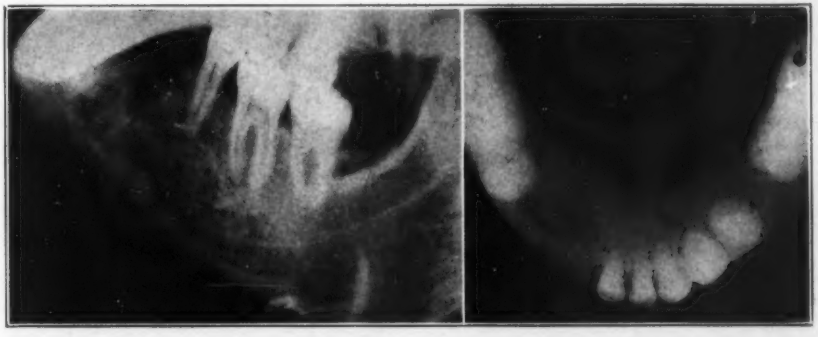

Fig. 2.—Left: Lateral view of jaw shows almost complete regeneration of bone (June 1, 1948). Right: Occlusal view. Sequestrums are absent and bone regeneration is almost complete

and enemas were employed and sedatives were given for pain. A hot flaxseed poultice was applied to chin, and penicillin was ordered, 50,000 units intramuscularly every three hours. Two days later the dosage was increased to 100,000 units. At that time the swelling had increased in size, beginning to be fluctuant, and appeared almost ready for incision and drainage. Dramatically, all his subjective symptoms of pain, malaise and so forth disappeared immediately and within a period of five days, the swelling of his chin subsided and complete resolution had taken place. The penicillin treatment was discontinued on May 12. He was now completely asymptomatic. The leukocyte count was 9,000 and he had regained 20 pounds of his weight.

COURSE—The roentgenogram at this time still showed marked osteolytic changes, since obviously it would take some time for bone regeneration to fill in the channels caused by the disease (Fig. 1). He was discharged from the hospital on May 16, 1947. His progress was uneventful and the final roentgenograms taken one year later show almost complete regeneration of bone (Fig. 2).

■ *Summary*

1. A case of osteomyelitis of the mandible was treated by chemotherapy without the necessity of any surgical intervention.

2. Penicillin was used in oral form and by parenteral introductions.

3. It would appear from the results of this case that parenteral introduction of penicillin is the method of choice in the treatment of mandibular osteomyelitis.

4. Improvement in appetite and general well being may be anticipated, not as a side action of the drug but as a result of control of the infection.[2]

5. It may be concluded that, by intramuscular administration of massive doses of penicillin in the early treatment of osteomyelitis, suppuration might not develop and surgical intervention might not be necessary.—*60 Franklin Street.*

2. Durbeck, W. E., Mandibular Osteomyelitis: Its Diagnosis and Treatment. *J. Oral Surg.* 4:55 (January) 1946.

Obstructive submaxillary salivary adenitis caused by foreign body: *report of case*

■ *James B. Smith, D.D.S., M.S., Danville, Pa.*

A boy, aged 14 years, was referred to the oral surgery department of the Geisinger Memorial Hospital on August 8, 1945, complaining of swelling and pain in the left submaxillary region.

HISTORY—The symptoms had begun one month previously with a painless swelling which had subsided a bit after rest in bed and sulfadiazine therapy as prescribed by his local physician. However, the swelling increased again two weeks later and this time was accompanied by severe pain which increased at meal time to the point where he could not finish a meal. Symptoms persisted continuously after that time, and his weight dropped from 130 to 120 pounds.

Previous to this illness the patient's health had been excellent. There was no history of serious sickness, injury or operation. He had not had a sore throat or respiratory infection previous to the onset of the prevailing illness.

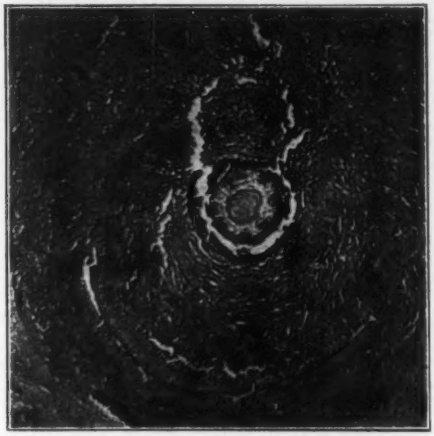

Fig. 1.—Cross section of the submaxillary duct showing collapse of lumen caused by inflammatory reaction surrounding the foreign body

EXAMINATION—On examination a mass 4 by 3.5 by 3 cm. in size could be felt lying just medial to the angle of the left mandible and protruding about 1.5 cm. beneath the lower border of the bone. This mass was firm, freely movable, lobulated and very tender to pressure. Bimanual palpation with one examining finger within the mouth verified the impression that the mass corresponded with the location of the submaxillary salivary gland, and slight pressure on the mass caused saliva containing semisolid yellow material to flow from the orifice of the left submaxillary duct. The oral hygiene was poor and several teeth had large cavities. The breath had a foul odor. The mouth temperature was 99.6 F. Intraoral roentgenograms of the floor of the mouth and lateral jaw roentgenograms of the submaxillary region failed to demonstrate any evidence of a stone in the gland or duct.

The patient was admitted to the hospital on August 8, 1945, for further study. Physical examination revealed nothing unusual except for the previously mentioned local findings. Results of the urinalysis were normal. The blood examination was reported as follows: hemoglobin 100 per cent, erythrocytes 5,060,000 per cubic millimeter, leukocytes, 6,550 per cubic millimeter, color index 1.0, neutrophils 66 per cent, small lymphocytes 32 per cent and metamyelocytes 2 per cent.

A diagnosis of suppurative submaxillary adenitis probably caused by obstruction of the duct was made.

TREATMENT—The patient received 20,000 units of penicillin intramuscularly every three hours for two days. He was given a liquid diet and hot, moist compresses were applied to the submaxillary region. The slightly elevated mouth temperature of 99.6 F. dropped to normal, and on the second hospital day the left submaxillary duct was probed back to the gland, but no stone could be felt. Extreme difficulty was experienced in gaining access to the left duct, but the duct on the unaffected side easily admitted the silver wire probe. Therefore, on the assumption that the orifice of the duct on the affected side had been injured slightly by chewing coarse food, and that the resulting scar tissue had caused a stricture, a plastic procedure was carried out to enlarge the duct orifice.

FIRST OPERATION—With the patient under 2 per cent procaine hydrochloride anesthesia, the duct was slit for a distance of about

Fig. 2.—Postoperative view of the wound after excision of the submaxillary gland

1 cm. and the mucous membrane of the duct was sutured to the mucous membrane of the mouth. He was sent home the following day with the request to return for observation as an outpatient.

During the three day hospitalization period, while the patient was on a liquid diet, the swelling in the submaxillary gland had subsided considerably. However, when the sutures were removed three days later, the gland was still enlarged and indurated even though a large probe could be passed easily into the duct and carried back to the gland without noticeable obstruction or the grating sensation such as a stone lodged in the duct would produce. Pain and increased swelling continued to occur at meal time.

One month after the first admission, he was readmitted for excision of the submaxillary gland. However, it was decided to try a prolonged course of penicillin therapy in heavy dosage, because there had been marked improvement the first time this drug was used. Therefore, he received 20,000 units of penicillin every three hours for six days. During this time his temperature was normal, but he experienced slight pain in the region of the gland at meal time. Because no marked improvement could be seen during this treatment, operation was advised, but the patient requested postponement of the operation so that he could attend a family celebration on Labor Day.

Upon readmission to the hospital nine days later, his physical findings were the same. Hemoglobin was 91 per cent, leukocytes 14,400 per cubic millimeter and results of the urinalysis were normal.

SECOND OPERATION—With the patient under cyclopropane-oxygen-helium anesthesia, the left submaxillary gland was removed on September 11, 1945. The submaxillary duct was ligated and sectioned close to the mucous membrane of the mouth. On examining the excised gland, a bristle resembling a grass stem 1 cm. long was seen, apparently protruding from the lumen of the duct. Microscopic examination of the slide made from the duct with the foreign body in place revealed a cross section of a vegetable fiber lying in the wall of the duct just outside of the lumen. The intense inflammatory reaction surrounding the foreign body had caused enough pressure to collapse the duct, as seen in the accompanying photomicrograph (Fig. 1), and to obstruct the flow of saliva.

On direct questioning the patient stated that he had placed a hard piece of grass stem in his mouth about one month before his first admission and had been unable to find the piece he had chewed off. This must have been the foreign body lodged in the wall of the duct.

Although the first attack of swelling and pain occurred within one week after biting the grass stem, he did not suspect the real cause of his trouble. He denied pain or bleeding at the time, and re-examination of mucous membrane of the floor of the mouth failed to show any evidence of recent or old injury. His postoperative course was uneventful and he has had no recurrence of symptoms.

The diagnosis of obstructive submaxillary adenitis is usually easy to make from the history of increased swelling and pain at meal time, and from the physical findings of an enlarged tender submaxillary gland with pus or pus-flecked saliva flowing from the orifice of the duct. It is usually easy to demonstrate a salivary stone by means of an occlusal roentgenogram of the floor of the mouth, or in a lateral view of the mandible and submaxillary region. However, this was a case where all classical symptoms were seen, but the cause of obstruction could not be found preoperatively.—*Department of Oral and Maxillofacial Surgery, Geisinger Memorial Hospital.*

VOLUME 7 • JANUARY 1949 • NUMBER 1 EDITORIALS

Reed O. Dingman, new editor of Journal of Oral Surgery

Reed O. Dingman of Ann Arbor has been appointed by the Board of Trustees of the American Dental Association to succeed Carl W. Waldron as editor of the Journal of Oral Surgery. He assumes the editorship with this issue.

Doctor Dingman, born in Rockwood, Michigan, November 4, 1906, received his dental degree at the University of Michigan in 1931 and his medical degree from that institution in 1936. One year in general surgery at Barnes Hospital, St. Louis, two years as director of the Department of Maxillofacial Surgery, Geisinger Memorial Hospital, Danville, Pennsylvania, and one year in private practice provided additional training which qualified him for the position of associate professor of oral surgery at the University of Michigan, which position he has held since 1943.

Doctor Dingman's training and experience, his wide acquaintance in the American Society of Oral Surgeons, the American Association of Maxillofacial Surgeons and the American Society of Plastic and Reconstructive Surgery, plus his many contributions to the literature on oral, maxillofacial and plastic surgery, make him a worthy successor to Doctor Waldron. It can be anticipated that the Journal of Oral Surgery, under the direction of Doctor Dingman and his editorial board, will continue to maintain the high standards developed by Doctor Waldron and his associates.

Concurrent with the change in editors the seventh volume of the Journal of Oral Surgery assumes a change in format which enhances its appearance and readability. Its contents promise to meet the same high standards established during the past six years. It warrants the continued support of all members of the profession who are interested in the practice of major or minor oral surgery.

Readers of the Journal of Oral Surgery regret Doctor Waldron's decision to retire, as under his direction the publication has developed into the official organ of oral surgery, devoted to the problems and advancement of that specialty of dentistry. Doctor Waldron will continue to serve on the editorial board where his six years of pioneering experience, counsel and advice will prove invaluable.

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The pathologic diagnosis of oral tumors

IN ANY PRACTICE of oral surgery there may occur tumors of the jaws that present extreme difficulty in exact pathologic diagnosis. Oral surgeons should be fully aware of this possibility of uncertainty and should establish a friendly cooperative relationship with the pathologists of their hospitals in order to facilitate pathologic consultation without fear of prejudice or any suggestion of lack of confidence. The need for such a friendly understanding is particularly evident in cases of certain connective tissue tumors of the jaws where the all important question of the benign or malignant character of a tumor may be subject to differences of opinion on the part of several pathologists. This may also occur in cases of ameloblastoma (adamantinoma) of the maxilla, which are notable for variations from the more typical microscopic findings of such tumors of the mandible. Such a situation may present an unavoidable but altogether unfortunate and disturbing problem for the oral surgeon in his treatment of the condition and in his discussions with the patient.

While it is not to be expected that oral surgeons become experts in the microscopic diagnosis of oral tumors, acquiring and maintaining a working knowledge of the subject will be of great interest to the oral surgeon and will prove helpful to him in the care of tumors of the mouth and jaws.

Most general hospitals have well trained pathologists on full time service, and the demand for pathologists is still greater than the large number completing graduate training. The increasing number of full time pathologists and the development of such hospital services affords an opportunity to the oral surgeons of the hospitals to cooperate with the pathologists in establishing a collection of oral pathologic specimens, microscopic slides and records. This will be of material interest and stimulation to both surgeon and pathologist, and mutual discussions will be of inestimable value to the oral surgeon. In due time a most worthwhile amount of oral pathologic teaching material will be available for the use of the staff and interns. In years to come, newly trained oral surgeons will have devoted up to six months or more to pathology in their graduate training and will undoubtedly maintain a continued interest in applied pathology. We may look forward with confidence to an altogether satisfactory service in oral surgical pathology notable for its cooperation and understanding. Such a favorable situation does not preclude the necessity of arranging for pathologic consultation when the need arises. It is significant that in many pathology departments of medical schools and hospitals the several members

of the staff may occasionally disagree on the diagnosis of a tumor and its altogether benign or potential malignant characteristics. It is obvious that a lone hospital pathologist is handicapped under similar circumstances. Mutual discussions on the subject of tumors of the jaws, the difficulties of roentgenographic differentiation, current literature, the activities of the Academy of Oral Pathology and the services offered by the Registry of Oral Pathology will provide a measure of understanding that will facilitate further consultations on certain obscure tumors.

The case reports to be cited are typical examples of conditions which should have the advantage of multiple consultations even though no final agreement ultimately may be reached. The oral surgeon, although somewhat confused by lack of definitive diagnosis, is supported in his efforts to handle the situation to the best of his ability, and his experience and horizon of service are thereby increased.

A 34 year old white woman noticed a gradual enlargement of the right side of her mandible beginning in the summer of 1945. When she applied for treatment several months later, a biopsy specimen of the lesion was taken and the diagnosis was osteoid-osteoma of bone. Conservative treatment was employed. Later a recurrence or extension of the process was noted. Another conservative operation was performed, but this time a diagnosis of osteogenic sarcoma was made. The patient was referred to us for radical surgery. Examination of the slides by a number of competent pathologists revealed a great difference of opinion ranging from "a fairly malignant sarcoma" to "a benign exostotic process." In view of the great difference of opinion, no treatment was carried out at that time. Five months later, the patient returned with several areas of extension and also complete regeneration in the previously operated area. The enlarged areas were removed by conservative excision. Again the pathologic diagnosis varied from sarcoma to a benign growth. This case was presented at the November 1948 meeting of the Academy of Oral Pathology. The opinion rendered at the meeting was that the growth was a benign extra-osseous chondrification process. The patient is living and well a year after the diagnosis of osteogenic sarcoma was made. There has been no evidence of metastasis. If the first diagnosis of osteogenic sarcoma had been followed without consultation, a radical resection of the mandible would have been performed.

A 52 year old white man had a tumor-like swelling of the face involving the left maxilla and side of the nose. An unerupted supernumerary tooth was near the area. The mass was excised and reported by the hospital pathologist as sarcoma of bone. A number of other pathologists examined the sections and diagnosed the condition as an inflammatory lesion. Again if the first diagnosis had been followed a radical maxillary resection would have been performed.

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In December of 1948, a slight enlargement in the floor of the nose indicated further exploration. This was done through an incision which permitted the hinging over of the lower half of the nose toward the right side to give wide access. A large amount of tumor tissue was removed. The posterior portion was softer and different in appearance from the more fibrous anterior portion. The frozen sections for biopsy and the permanent sections proved this to be transitional cell carcinoma (lymphoepithelioma). Roentgenologic and radium treatment was instituted for this rare but highly malignant tumor. This diagnosis was not suspected from the biopsy reports of two previous examinations.

A 12 year old white girl had a marked enlargement of the left maxilla. A biopsy had been performed elsewhere and reported as osteogenic sarcoma. The left antrum was explored and a thick walled, large cyst was encountered, but there was no evidence of a tumor. The pathologic diagnosis of a dental cyst and chronic inflammation was made. Postoperative difficulties with obstructed drainage and infection occurred, and a second operation to enlarge an antronasal window was undertaken. Tissue removed again showed chronic inflammation and no evidence of sarcoma. One year later, what appeared to be a cystic area above the incisors was explored, and instead of a cyst a mass of soft tissue was found. This was diagnosed as osteogenic sarcoma. The patient received an intensive course of radiation therapy which was followed by a severe local and systemic reaction. The buccal and palatal enlargement decreased to a considerable degree, and a second course of radiation therapy was given. Subsequent recovery was complete. Mobile teeth apparently held only by gingival tissues became firmly embedded in a completely regenerated maxilla. The patient has grown normally and is living and well four years after treatment. A subsequent recheck study of the slides by a number of pathologists showed that the diagnosis of osteogenic sarcoma was erroneous, and that the condition though obscure was inflammatory. It is difficult to understand the absence of osteoradionecrosis which was anticipated on account of the associated infection and intensive radiation therapy.

A 16 year old white girl had an extensive tumor involving most of the left side of the mandible. Material removed for biopsy was myxomatous, and the pathologists disagreed as to diagnosis. Several pathologists believed it to be a myxosarcoma and advised radical resection. Conservative curettement, however, was employed. The patient is living and well five years after treatment. The slides later were examined at the Army Institute of Pathology, and a diagnosis of soft odontoma was rendered.

A 6 year old white girl had a radiolucent area of bone destruction at the angle of the right mandible. At operation the area contained soft friable material. Frozen sections were diagnosed by the hospital pathologist as undifferentiated sarcoma. Because the

clinical characteristics were those of a benign growth, conservative curettement was employed. Later, paraffin sections revealed the growth to be a typical solitary eosinophilic granuloma of bone.

Numerous other cases of similar import could be cited. In a recent case of a tumor of the palate, the biopsy report made eight months previously was ameloblastoma. A recheck of the slides was diagnosed mixed tumor. The ill defined tumor excised at operation was diagnosed as ameloblastoma. Study of these slides at the recent symposium on bone tumors of the American Academy of Oral Pathology confirmed the diagnosis of mixed tumor with potential basal cell malignant tendencies.

A note of caution might be employed in considering diagnosis rendered from a frozen section at operation. Fine cell detail is often difficult to make out in the frozen sections and an erroneous diagnosis may result in certain cases.

Surgeons and pathologists must cooperate to avoid unnecessary radical and mutilating operations on patients with tumors.

History repeats itself. A quarter of a century and more ago, mandibles were resected for giant cell tumors (then termed giant cell sarcoma). Similar radical surgery still is performed for ameloblastoma in spite of the modern concept that such tumors are rarely if ever malignant. Some show marked activity and require extensive operative procedures. Likewise the rechecking of large numbers of mandibles excised for osteogenic sarcoma demonstrates that in a considerable number of instances such radical surgery was unnecessary as the reexamination of the microscopic slides places the tumors in the group of ossifying fibromas and allied benign tumors.—*Carl W. Waldron and Charles A. Waldron.*

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ATLAS OF DENTAL AND ORAL PATHOLOGY. *By Lt. Col. Joseph L. Bernier, D.D.S., M.S., and Colonel J. E. Ash, M.D. Fourth edition. 236 pages, 484 illustrations, 150 plates. Price $7. Washington, D. C.: American Registry of Pathology, Registry Press, 1948.*

The fourth edition of this most useful Atlas is a decided improvement over previous editions, having been rewritten with new photomicrographs that are much superior to those in the third edition. The change of format and formal text arrangement present sufficient authentic subject matter for most of the requirements in the teaching of dental and oral pathology, and it is a useful reference text for the graduate student and the practicing oral surgeon.

The first three chapters cover embryology and histology, the pathology of the hard dental structures, and pathology of the soft dental structures, respectively, and present complete and informative discussion of these subjects. The fine illustrations provide the dentist with much that will be helpful to him in practice and provide a fundamental background to enable the oral surgeon to understand more clearly the subsequent chapters that are devoted to surgical conditions.

Chapter IV contains a workable classification of odontogenic tumors, ectodermal, mesodermal and mixed origin. The accompanying photomicrographs of ameloblastoma, soft mixed odontoma, dentinoma, cementoma and mixed odontoma are excellent.

Chapter V—odontogenic cysts—might better have been titled cystic tumors of the jaws in that it covers follicular cysts, also median, nasopalatine, and globulomaxillary cysts. Cysts of tissues outside the substance of the jaws, dermoid, mucocele, and retention cysts of the salivary glands, discussed in this chapter might well have been placed in Chapter VII.

Hypertrophic, trophic and inflammatory lesions of the oral mucous membrane are discussed in Chapter VI as well as certain conditions of the salivary glands.

Chapter VII covers a wide variety of oral lesions of specific etiology, Vincent's infection, dilantin gingivitis, diabetic stomatitis, syphilis, tuberculosis, lupus, actinomycosis, sporotrichosis and the effects of the atom bomb.

Chapter VIII—benign oral tumors—includes tumors of the gums and gingiva as well as those of the oral mucous membrane. Peripheral and central tumors of the jaws and tumors of the salivary glands and neck are discussed in the text, and a fine series of photomicrographs is presented.

The important subject of malignant ectodermal tumors, basal cell, basal squamous cell, squamous cell, adenocarcinoma, transitional cell carcinoma and metastatic carcinoma, is thoroughly discussed in the text matter in Chapter IX. The photomicrographs and photographs of this chapter are excellent in every particular.

Chapter X—malignant mesenchymal tumors—includes fibrosarcoma, chondrosarcoma, osteogenic sarcoma, reticulum cell carcinoma (lymphosarcoma), myeloma, Ewing's tumor (endothelioma) and metastatic tumors of connective tissue origin.

The bibliography is well chosen from the standpoint of tumor pathology. Other references covering the applied surgical pathology of the oral tissues would be a valuable addition to the text.

This Atlas will be of great value to the oral surgeon, and it is suggested by this reviewer that it be read from cover to cover and while doing so the oral surgeon might make notations regarding the topographic incidence of the various lesions and tumors so that he may prepare an index that will indicate the text pages, photomicrograph pages and illustration pages for the various lesions and tumors affecting the gingiva, the oral mucous membrane, the floor of the mouth, the tongue, the lips, salivary glands, peripheral and central tumors of the jaws, etc. Such an index, if inserted in the book, will be a great time saver for ready reference in the everyday practice of the oral surgeon.—*Carl W. Waldron.*

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ORAL SURGERY. *By Kurt H. Thoma, D.M.D. 1,521 pages, 1,631 illustrations, 121 in color. Price, cloth, $30. St. Louis: C. V. Mosby Co., 1948.*

To present in a few paragraphs an adequate review of a two-volume text of 1,521 pages, which represents many years of conscientious study and wide clinical experience, is a formidable task.

Chapter I, Volume I—The Principles of Surgery—is well organized and informative, covering subject matter essential to the practice of oral surgery. It is to be regretted that the exact technic of the intraoral block anesthesia of the maxillary nerve described by Jorgensen was not included. Also the illustrations of plastic flaps fail to show Z-plasties, VY, and rotation flaps—so useful in the plastic surgery of the oral mucous membrane.

Chapter II—The General Care of the Patient—presents a most valuable and modern discussion of infections, chemotherapy, shock, systemic diseases, pre- and postoperative care.

Chapter III—Dentoalveolar Surgery, 287 pages of text and references—is a comprehensive coverage of the extraction of teeth, alveoplasty, alveolectomy, impactions, gingival hypertrophies, fibromatous and bony enlargement of the tuberosities, ridge extensions, the abnormal frenum, dentigerous cyst, surgical eruption of teeth, apicoectomy, gingivectomy, dentoalveolar, subperiosteal and gingival abscesses. Technics are explained fully, and the illustrations are excellent. In the discussion of ridge extension, no mention is made of the intraoral skin graft found so useful in the formation of adequate ridges in war injury cases. The surgical technic shown for treatment of enlarged tuberosities would seem to be hazardous from the standpoint of the multiple sites of excision and undermining excisions having a possible bad effect upon the blood supply of the margins of the flaps. This chapter would be more useful if rearranged into sections.

The same may be said for Chapter IV—Treatment of Traumatic Diseases of the Jaws, 354 pages. The general considerations of care of jaw and facial injuries including methods of examination, classification, first aid and systemic treatment, supportive bandaging, temporary wiring and repair of soft tissue wounds are discussed adequately. The description of roentgen technics is inadequate for a systematic survey of facial injuries. Water's sinus position is not stated correctly, and the most important routine posteroanterior projection for facial bones is not described, nor is its anteroposterior counterpart so useful where a patient may not be moved or placed on his face on account of other injuries. The treatment of fractures of the middle third of the face is covered in detail with descriptions of most of the standardized methods and head appliances that have been devised by numerous authors. A fuller discussion of the fundamental problems of correction of displacements and treatment planning that anticipates progressive steps from the more simple to the more complicated in case of difficult reduction would be of great service to the less experienced reader. No mention is made of the danger of establishing the occlusal level at too high a horizontal plane when craniofacial wires are employed in cases of marked comminution of the maxilla.

Fractures of the malar zygomatic compound deserve more discussion from the standpoint of types of displacements and more simple but well established methods of treatment rather than the more radical care of the cases reported.

Two hundred and fifty pages are devoted to fractures of the mandible. The author's concept that teeth in the line of fracture even though uninjured should be extracted promptly to avoid complication of infection is in complete variance with the extensive experience of large numbers of oral surgeons who are sure that prompt reduction and complete immobilization are the most important factors in preventing infection. This experience over many years without the aid of sulfonamides or penicillin is made even more certain under modern antibiotic therapy, and makes unnecessary many of the radical procedures described in the text. Most of the conventional useful methods of wiring of fractures are adequately described and illustrated. The extremely useful Risdon external arch twisted horizontal wiring could well have been illustrated by diagrams in addition to being described. Circumferential and internal

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fixation by wires and plates are discussed with well selected illustrations to accompany the text. The technic of skeletal pin fixation is presented in an effective manner along with many illustrations.

An evaluation of the advantages and disadvantages, indications and comparative merits of these methods would be of interest. The author's concept of the treatment of fractures and fracture dislocation of the condyle is as anticipated at variance with the conservative handling of such fractures by most surgeons. The author's technic is given in detail, and his obvious desire to obtain the best anatomic reduction of displacement is to be commended. It is the opinion of this reviewer that only an intensive survey and evaluation of the final functional results of conservative and open wiring, plate or pin fixation of a large series of cases will settle this controversy. The treatment of complicated fractures, infections, osteomyelitis, delayed union, nonunion, malunion and infections of the maxillary sinus is an important contribution to this chapter to which is added an extensive bibliography.

Chapter V is a well presented discussion of maxillary sinus diseases and conditions of dental origin. Osteomyelitis and necrosis of the jaws are covered in Chapter VI in a most effective and complete manner. The general and supportive treatment is given in detail and the surgical procedures of drainage, sequestrectomy, saucerization, fixation of pathologic fractures and excision of affected segments of bone are described with fine illustrations. Syphilitic osteomyelitis is included.

Chapter VII, Volume II, is devoted to treatment of diseases of the mandibular joint, including ankylosis. Much valuable information is presented. In the discussion of interdental splints to relieve the traumatism of joint surfaces and subsequent permanent restorations, the statement that the mandible must be positioned correctly in centric relationship with the condyles in *the most retruded position* is at variance with the concept of many men with wide experience in this field. In the majority of cases of temporomandibular joint retrusion and overclosure, the occlusion of the teeth is such that with splinting the condyle may not only be lowered but moved slightly forward to a more normal relationship with the eminentia articularis by establishing a more normal and somewhat forward occlusion. Much is still to be learned concerning the over-all and progressive care of these conditions, so important to dental practice. Five detailed case reports of surgical treatment of ankylosis are presented. The follow up notes of two and a half weeks, one week, three and a half weeks, four months and six weeks after surgery are entirely inadequate for an effective discussion and evaluation of the problems of ankylosis of the jaws.

Infections of the face and neck are *covered* in a most systematic manner in Chapter VIII. Included are discussions of the fascial spaces and the modern application of effective antibiotic treatment combined with adequate surgical intervention. The case reports are of great interest and practical value to the reader in that the details of management, surgical procedures and after-care are described fully.

Chapter IX is a well organized discussion of diseases of the salivary and mucous glands containing much helpful information for the oral surgeon. Dermoid cysts of the floor of the mouth are included.

Chapter X—Diseases of the Fifth and Seventh Nerves—includes anatomic considerations, disturbances of sensation, impairment, anesthesia, paresthesia, symptomatic neuralgia and tic douloureux. Case reports of decompression of the mandibular canal to relieve nerve impingement and neurorrhaphy for reconstruction of the canal with repair of the nerve are presented. It is unfortunate that follow-up notes covered less than one month in these most interesting cases. No mention is made of the usefulness of decompression of the infraorbital nerve in old united displaced fractures of the malar bone. The improvement of facial paralysis by means of slings of strips of fascia lata or tantalum wire is described. Reference might well have been included to the methods that give some movement to the paralyzed face by utilizing the masseter and temporal muscles.

Chapter XI is an outstanding, well organized discussion of every aspect of the treatment of cysts of the jaws so frequently undertaken by the dentist. Details of operative procedures

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are complete in every particular. Numerous case reports are interesting and informative.

Chapter XII covers the treatment of a wide variety of benign tumors of the mouth and jaws in a most effective manner. Included are tumors of soft tissues, tumors of the gums and gingiva, peripheral tumors of bone, odontogenic and other central tumors of the jaws. The numerous case reports with fine illustrations have been selected with great care and are valuable additions to the text.

Chapter XIII is devoted to the treatment of malignant tumors of the lips, oral cavity and jaws. The preliminary discussion of surgical diagnostic and therapeutic procedures is fundamental in every particular. Case reports are excellent with operative technics and postoperative cases reported in detail. In the latter part of this chapter are discussed fibrosarcoma, lymphosarcoma, malignant melanoma, osteogenic sarcoma, Ewing's tumor and myeloma.

The final chapter, XIV, is given over to the surgical treatment of deformities of the jaws. The various methods of correction of mandibular prognathism are described, the author's preference being the intraoral and extraoral removal of sections of bone from the body of the mandible. More attention should have been given to the preoperative study of casts and duplicate casts in evaluating the relative advantages of osteotomy of the ramus or osteoectomy of the body from the standpoint of the best resulting occlusion in the individual case. This will be a more important consideration in the future with more patients possessing a full complement of teeth. The valuable method of resection in the third molar retromolar region is not mentioned. The author's discussion of open bite deformity with ectopia is complete with adequate illustrations as is his discussion of the treatment of retrusion deformities and facial asymmetry.

This comprehensive text provides most interesting and instructive reading in the wide field of oral surgery. It is written in easy and clear language with obvious attention to details so often omitted from surgical texts and articles. The illustrations are excellent except for many posteroanterior X-rays that might well have been reduced sufficiently in size to permit an adequate inclusion of the malar zygomatic and condylar regions. Cross references to pages as well as chapters would be of great service to the reader. Much could be accomplished in facilitating the finding of specific information in Chapter IV—Traumatic Diseases of the Jaws—by subdivision of this chapter and page cross references.

This text is much too comprehensive for the undergraduate student but will be found of value to interns, residents and graduate students in oral surgery as a reference text. Practicing oral surgeons will find Volume II most useful for reference.—*Carl W. Waldron.*

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CONDYLAR GROWTH AND MANDIBULAR DEFORMITIES. *M. B. Engel and A. G. Brodie, in Surgery 22:976, 1947.*

This report is an analysis of 19 cases of arrested growth in the mandibular condyles and their subsequent deformities. It is the purpose of the study to emphasize the importance of the development and function of the jaw in the condylar area.

Mandibular growth results from an integration of activities in numerous areas and thus arrest of growth in the condyles results in pronounced mandibular deformities.

The authors give a very brief description of the development of the mandible and include several photomicrographs of the normal developments.

The condylar development is maintained in activity until about the twentieth year and this growth results in the normal forward and downward vector for the mandibular growth as well as the increased width of the jaw.

Disturbances in the growth of the mandible may occur as a result of mastoiditis or middle ear infection, hematogenous infections, infections in dental areas, or from injuries resulting in fractures or in disturbances of the bone-forming cartilage. Also, generalized arthritis involving the temporomandibular joint may result in arrest of development. Also, in animals, endocrine disturbances have been found to be a cause.

A series of 19 cases with history of involvement of the condyle was studied. The injury of the condyle was determined on the basis of history, x-ray studies of the area (cephalometric, laminagraphic and routine temporomandibular films), and analysis of joint function.

In several instances it was possible to follow the same individual serially over periods ranging from one to twelve years. In 8 cases the involvement was bilateral. Unfortunately, however, the histories were incomplete in many cases. Many cases gave a history of growth arrest that was early or congenital in origin. Others revealed an association of infections with subsequent ankylosis, but significant functional impairment was not always present. Orthodontic treatment was attempted in 8 cases, and 6 patients had arthroplasties.

For purposes of comparison the tracings of the mandibles of the same individual were superimposed upon the anterior portion and lower mandibular border as regions of relative stability since apposition and remodeling are minimal in those areas. The authors describe other measurements made of the jaws in their cases.

The clinical findings showed that when there was unilateral involvement the unaffected side usually appeared flat and underdeveloped, while the arrested side of the face gave the impression of fullness. The mandible was skewed toward the side of the affected condyle. There was generally notching of the lower border or the ramus-body junction. The patient was frequently unable to deviate the jaw toward the normal side.

With bilateral arrest of growth there was usually a symmetrical type of deformity resulting in a *Vogelgesicht* with a very retruded mandible and the chin lying in the hyoid region. Lateral function was not always possible and the antegonial notching was present bilaterally.

The authors give a description of the roentgenological findings in the cases of unilateral and bilateral involvement. The authors also give a discussion on the disturbance of growth in these cases and state that sometimes growth may slowly begin again even though there appears to be a stoppage of growth, and therefore surgery is contraindicated unless it is definitely shown that all growth has been stopped by repeated examination of the patient. Surgery is not contraindicated if the cartilage has been prematurely ossified or so badly scarred as to preclude further growth. In older individuals the possibility of additional growth of the jaw does not constitute a problem.

Some authors believe that muscle imbal-

ance is a major factor involved in producing the dysplasia. In the author's opinion the validity of such an assumption is difficult to sustain because of the following findings:

1. Resections of either the condyle or horizontally through the superior portion of the ramus for the correction of mandibular prognathism in older people did not result in any significant change in the form of body of the mandible over a period of years.

2. Injury to the condylar area in the cases reported here was not always associated with muscle disturbance as evidenced by the normal range of functional movements in some cases.

3. The authors have seen cases of functional limitation of obscure etiology in which there is almost complete inability to open the mouth, and in which the condylar area was undisturbed. In these individuals there was no deformity of the jaw.

4. This deformity does not occur in adult temporomandibular ankylosis.

The authors then briefly discuss the treatment in these cases, stating that it is very difficult and that orthodontic treatment is capable only of modifying the alveolar process. The orthodontist can strive only for a correction of the occlusal relations of the teeth.

The efforts of the plastic surgeon together with those of the orthodontist are necessary to attain cosmetic improvement.

The authors include several photomicrographs of normal jaw development and photographs of several of their patients, as well as some roentgenograms. Some graphs are also included to show the relationship between normal and abnormal growth of the jaw.—William A. Ahroon, in International Abstracts of Surgery, *Surg., Gynec. & Obst.* 86:542 (June) 1948.

MYOSITIS OSSIFICANS OF THE MASSETER MUSCLE. A CASE REPORT. *Joseph G. Kostrubala and Raymond J. Talbot, in Plast. & Reconstr. Surg. 3: January, 1948.*

SUMMARY AND CONCLUSION

1. Myositis ossificans of the masseter muscle is rare. Only three cases were reported in 1924.

2. There is a remarkable tendency for recurrence of calcification when the bony mass is removed. This is probably due to the fact that the space produced by removal of the bone cannot be easily obliterated.

3. A case of myositis ossificans is presented which was successfully treated by filling the space with a dermal graft.

HEMANGIOMAS OF THE MOUTH. *Frederick A. Figi, in Ann. Otol., Rhin. & Laryng. 56: December, 1947.*

SUMMARY

The various forms of hemangiomas occurring about the lips and mouth are reviewed, and the treatment of these different lesions and of the phleboliths at times encountered in cavernous angiomas is discussed. In general, radiation is the treatment of choice for strawberry birthmarks and cavernous hemangiomas in infants and small children. In adults cavernous lesions are more effectively treated with electrocoagulation and injections of boiling water or chemical sclerosing agents. Well-circumscribed hemangiomas often are best excised. Plexiform or racemose hemangiomas usually require ligation of the afferent vessels in addition to the measures employed in treatment of cavernous hemangiomas.

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